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GENERALIZED ELECTRONICS MAINTENANCE MODEL (GEMM)

Robert Dale White, et al

Army Electronics Command
Fort Monmouth, New Jersey

November 1971

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13. ABSTRACT

The rapid advances in technology and the ever-changing mission requirements of today's Army create a multitude of problems in the logistics support area. With support costs over the life cycle averaging from 10-100 times greater than procurement costs for electronic equipments, it becomes obvious that the area of logistics support requires a great deal of detailed scrutiny and analysis. What is not so obvious is that this analysis cannot be restricted to logistics support per se.

The effect that design parameters have on logistics support must be determined. This interaction between design and logistics support permits trade-off analysis for the express purpose of optimizing the logistics profile with respect to effectiveness constraints.

In order to accomplish trade-off analyses in a timely manner, it is necessary to employ the technique of mathematical support modeling. A support model is a mathematical representation of an actual support system that permits detailed support requirements analysis and design trade-offs. The Generalized Electronics Maintenance Model (GEMM) is such a model, designed in-house by ECOM personnel for the study of ECOM equipments.

GEMM is a management tool designed to assist the manager in the decision-making process during the development of prime equipment and its supporting logistics system. Implementation of GEMM will provide management with the capability to study the interaction of the many elements of equipment design and logistics support and the effect that each element has on life cycle support costs and operational availability. The effect that changes in spare policies, manpower, test equipment and transportation will have on the life cycle support costs and operational availability can be shown over a wide range of values.

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Sensitivity Analysis						
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Utilization of support models, such as GEMM during the early stages of an equipment design and continuing throughout its life cycle, is the only method by which accurate and timely decisions can be rendered concerning the support of modern Army equipments.

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CHAPTER I

INTRODUCTION

This document is the final report on the Generalized Electronics Maintenance Model (GEMM). GEMM is an integrated design and logistics support model written in FORTRAN IV computer language. This report contains information of the purpose of GEMM, the model inputs and outputs, logic flow, derivation of equations, sensitivity analysis, and two sample problems utilizing GEMM. In addition, the appendices contains the computer flow chart, a program listing, a description of input data requirements, and an identification list of variable names.

BACKGROUND

A study proposal for this model was developed by the Systems Analysis Division of what was then the Systems/Cost Analysis Office and first presented to the ECOM Special Studies and Review Board in November of 1969. This proposal was approved in December and the importance of the project was recognized and emphasized by the Deputy Commanding General, ECOM. In March of 1970, a meeting was held between Systems Analysis Division and Maintenance Engineering Directorate to discuss support modeling relative to Integrated Logistics Support. This meeting resulted in a joint venture to develop GEMM with both activities supplying the necessary resources. The GEMM development was initiated in April of 1970 and two man-years of effort has been required for this development.

SUPPORT MODELING

The GEMM model belongs to that class of mathematical models normally referred to as a "Support" model. A "Support" model is a representation of an actual support system. This representation may be accomplished in a number of ways but the most common means is by simulation or mathematical equations or a combination of both. Some support models can be exercised by hand but in most cases support models are computerized.

The definition of simulation is "to have the external characteristics of or to look or act like." This is analogous to building a scale model of an airplane to test its air flow characteristics. Applied to simulation support modeling, this means that a computer model is built that has the charateristics of and acts like an actual support system.

The type of model utilizing mathematical equations is called an analytical model. This type of model utilizes mathematical equations to calculate the elements of the actual support system in question. Mathematical relationships are derived that enable the determination of spare requirements, maintenance manpower requirements, and other support elements.

By utilizing a computer model of an actual support system, it is possible to obtain much information about a system at a substantial savings compared to study of the actual physical system.

The steps that are taken during the development of a support model are extremely beneficial. The first step that must be undertaken in the development of a support model is the determination of all the key elements of support. This is a big job in itself and one which imparts a great deal of useful knowledge to the model developer. An abundance of insight into various phases of support is a side product of this activity.

An in-depth evaluation of maintenance and logistic flow must be completed before a simulation or an analytical support model can be developed. Once again, thedesirable side effect of this task is a better understanding of the maintenance and logistics system and its problem areas.

The determination of the possible support policies for various equipments requires a great deal of investigation into equipment repair and maintenance procedures and a thorough understanding of transportation problems, stockage procedures, repair shop operation and other phases of maintenance support. The support model must be developed in such a manner that it can be readily applied to a wide-range of support problems. The detailed investigation of maintenance and logistics discussed above enables the development of a support model with the necessary ingredients of versatility and applicability.

GEMM APPROACH

For the GEMM program the decision was made to develop an analytical support model rather than a simulation model. This decision was based on several factors. A support model was needed that could be exercised several times during the life cycle of an equipment with rapid turn around so that timely decisions could be reached through application of the model. Also a great deal of sensitivity analysis will be required to facilitate the evaluation of alternate design and logistics plans from the standpoint of life cycle support costs and operational availability. The amount of analysis that would be required is substantial. This type of analysis takes time and costs money. The computer time required and the huge amounts of input data required for simulation makes the simulation approach prohibitive. The type and quantities of data required for large simulation simply is not available and the validity of this type of data is highly questionable.

To be realistic, GEMM is capable of evaluating thirty-five different possibilities of maintenance allocation. These maintenance allocations cover the realm of possibilities which could actually occur within the Army structure.

For the most part, GEMM utilizes mean value for input data. This type of data is available or may generally be obtained within the Army structure. GEMM does, however, consider confidence limits for stockage based on the Poisson Distribution, via TM 38-715-1.

Again, to be realistic, GEMM is compatible with the force structure approach. GEMM can consider almost any type of force structure from a battalion deployment to a field Army. Force structure data such as number of equipment in the force structure, the number of organizational, direct, general and depot support shops, distances between shops, etc., are required by GEMM. Decisions made by the model are based on life cycle support costs. Additionally, the operational availability of the end item will be calculated for the optimum policy. Operational availability is the availability of the end item to the user in the field taking into consideration both the design and logistics system.

This computerized model is not a compilation of sophisticated mathematical manipulations. It makes use of standard Army methods of determing logistics support requirements. The attribute of GEMM is not its utilization of complex computer-oriented operations research techniques but the speed with which it performs previously manual calculations and the integration of design and logistics variables to provide a total-picture approach to design and logistics decision-making.

GEMM APPLICATIONS

GEMM is a management tool designed to assist the manager in the decision-making process during the development of prime equipment and its supporting logistics system. Implementation of GEMM will provide management with the capability to study the interaction of the many elements of logistics support and the effect that each element has on the support system life cycle costs.

The effect that changes in spares policy, manpower, test equipment, etc., will have on the support system life cycle cost and the equipment operational availability can be shown over a wide range of values. Likewise, the effect of design changes in reliability and maintainability can be assessed and Reliability versus Maintainability Trade-Offs can be performed. These investigations can be accomplished using estimated and predicted values to assist in the decision-making in the early design stages before equipment design and logistics policy have been firmly definitized.

The speed with which GEMM can be exercised on the computer permits sensitivity analysis yielding instantaneous evaluation of alternative solutions, thereby creating a direct man-machine interface. Many iterations of the input data such as different MTBF's, MTTR's, stockage confidence levels, and many other input variables. This sensitivity analysis will permit detailed analysis of the effect of design and logistic parameters on

life cycle support costs and operational availability. Sensitivity analysis can be used to pin-point system parameters that will have a significant impact on life cycle support costs and operational availability in order to "zero-in" on these critical factors.

Furthermore, the model can be exercised with updated information as performance data becomes available to verify earlier decisions. The maintenance philosophy of fielded equipment can be analyzed to determine if certain changes might yield a more cost effective support system. The advantages of the model are varied and as experience is gained in its use, applications in areas other than those discussed herein will no doubt be discovered.

CHAPTER II

MAINTENANCE OPERATIONS

There are four categories or echelons of maintenance in an Army theater of operations. These categories are: Organizational Support (O), Direct Support (DS), General Support (GS) and Depot Support (D). Figure 1 briefly describes the type of work normally accomplished at each echelon, the location where the work is done, the person or group doing the work, the equipment that is maintained, and the basis of the repair action. This figure describes maintenance operations as they are normally performed within the Army. There are certain equipments that do not lend themselves to this type of organization of maintenance. And other equipment, while lending themselves to this type maintenance structure, might be repaired more efficiently with a resulting lower cost if allowed to follow some other maintenance policy.

The GEMM model is not constrained to the general maintenance organization shown in this figure. It has the flexibility to investigate various structures. To accomplish this variation of structure, it was necessary to identify several maintenance actions without restricting the echelon at which they could occur (except in one instance).

These maintenance actions are: Check-Out Equipment (COE), Fault Isolate to Component (FIC), Fault Isolate to Module (FIM), Fault Isolate to Part (FIP), Throwaway Module (TAM), Throwaway Component (TAC), and Throwaway Equipment (TAE). COE is the only restricted action and it must be accomplished at organizational support. COE is the action required to determine that the equipment has failed. FIC is the maintenance action that is required to fault isolate the failed equipment down to the component level, i.e., to locate the failed component and it can occur at any one of the four echelons.

Correspondingly, FIM is the action required to locate the failed module and FIP is the action required to locate the failed part. It is assumed that the actions must be performed in sequence, i.e., before FIP can be performed it is necessary to perform COE, FIC and FIM respectively. Figure 2 denotes the equipment breakdown and the order of performance of these maintenance actions.

To make GEMM general purpose it was necessary to consider a wide range of maintenance philosophies. These philosophies are made up of the functions described above and the different philosophies exhibit differences due to the echelon at which the maintenance functions take place. After extensive analysis, it was determined that thirty-five maintenance philosophies defined the universe of possibilities for Army electronic equipment. Other possibilities were removed from consideration as being infeasible.

Category	Organizational Maintenance		Direct Support Maintenance	General Support Maintenance	Depot Maintenance
Former Echelon	First	Second	Third	Fourth	Fifth
Done Where	Wherever the Equipment is	In Unit	In Mobile and/or Semi-Fixed Shops		In Base Depot Shop
Done by Whom	Operator	Using Unit	Division/Corps/Army		Theater Communication Zone and/or Z/I (USA)
On Whose Equipment	Own Equipment		Other People's Equipment		
Basis	Repair and Keep it		Repair and Return to User		Repair for Stock
Type of Work Done	Inspection Servicing Adjustment Minor Repairs and Modification		Inspection Complicated Adjustment Major Repairs and Modification Major Replacement Overload from Lower Echelons		Inspection Most Complicated Adjustments Repairs and Replacement Including Complete Overhaul and Rebuild Overload from Lower Echelons

FIGURE 1 CATEGORIES OF MAINTENANCE IN A THEATER OF OPERATIONS

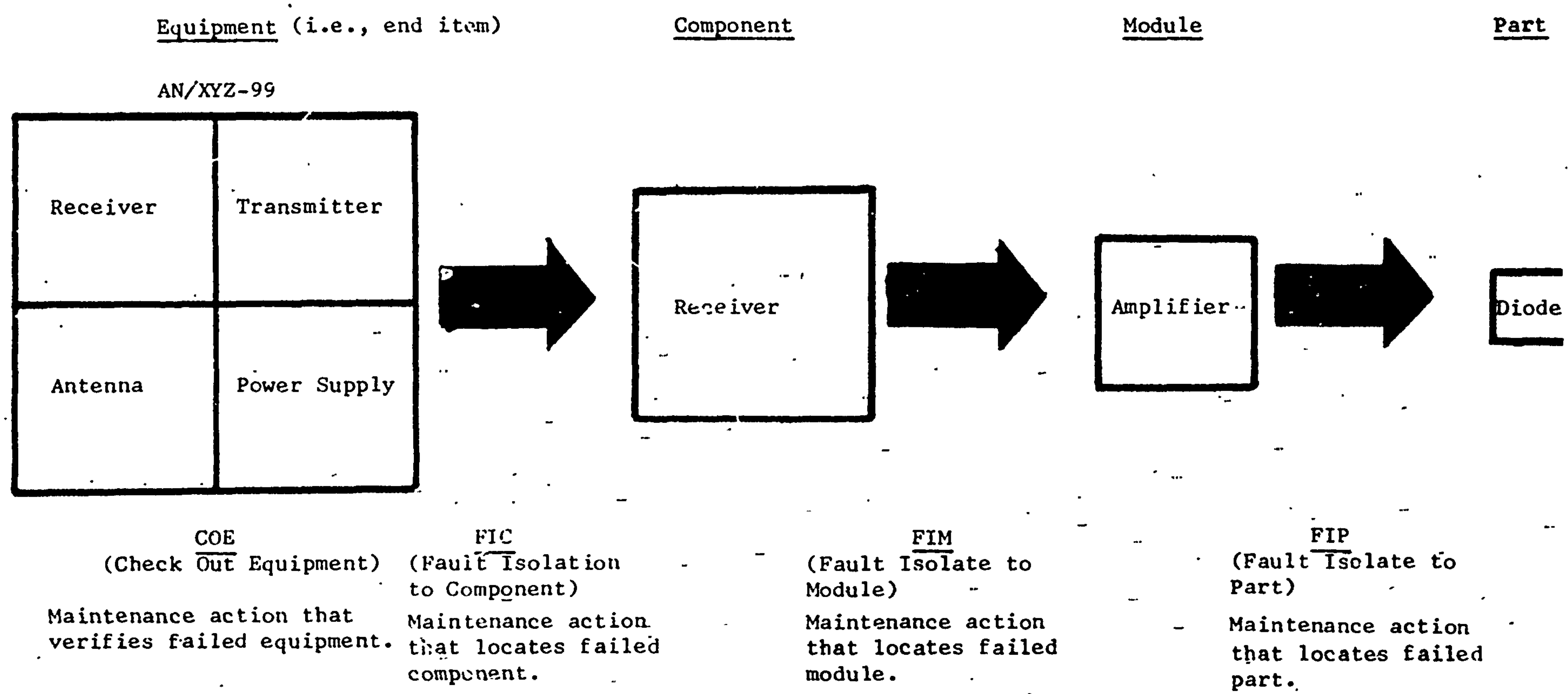


Figure 2. Equipment and Repair Terminology

These thirty-five possibilities will cover any situation of equipment type, operational environment, maintenance structure, etc.. Figure 3 is a list of these possibilities. Similarly, Figure 4 is a graphical tree representation of these same thirty-five possibilities.

It is important to understand that for one and the same equipment, it may be possible, and desirable, that several of these philosophies describe the maintenance actions required to maintain the equipment in an optimal manner. For example, a particular radar equipment might exhibit one throw-away component, while another component might require FIM at the DS level and still another might require FIM at GS. Likewise, some modules might be thrown-away rather than repaired while others might be repaired at different maintenance echelons. This is a real situation and one that places a definite requirement on the evaluation capability of GEMM. Other models were investigated and found to be excellent in many respects. However, too many models could not consider the repair of modules at different echelons nor could they evaluate component repair at different levels. This is a "must" as far as realism and versatility is concerned in a support model.

POLICY	COE	FIC	FIM	FIP	TAE	TAC	TAM
1	O	O	O	O			
2	O	O	O	DS			
3	O	O	O	GS			
4	O	O	O	D			
5	O	O	O				O
6	O	O	DS	DS			
7	O	O	DS	GS			
8	O	O	DS	D			
9	O	O	DS				DS
10	O	O	GS	GS			
11	O	O	GS	D			
12	O	O	GS				GS
13	O	O	D	D			
14	O	O	D				D
15	O	O				O	
16	O	DS	DS	DS			
17	O	DS	DS	GS			
18	O	DS	DS	D			
19	O	DS	DS				DS
20	O	DS	GS	GS			
21	O	DS	GS	D			
22	O	DS	GS				GS
23	O	DS	D	D			
24	O	DS	D				D
25	O	DS				DS	

Figure 3. Maintenance Policies (Sheet 1 of 2 sheets)

POLICY	COE	FIC	FIM	FIP	TAE	TAC	TAM
26	O	GS	GS	GS			
27	O	GS	GS	D			
28	O	GS	GS				GS
29	O	GS	D	D			
30	O	GS	D				D
31	O	GS				GS	
32	O	D	D	D			
33	O	D	D				D
34	O	D				D	
35	O				O		

Figure 3. Maintenance Policies (Sheet 2 of 2 sheets)

CHAPTER III

CALCULATION PROCESS LOGIC

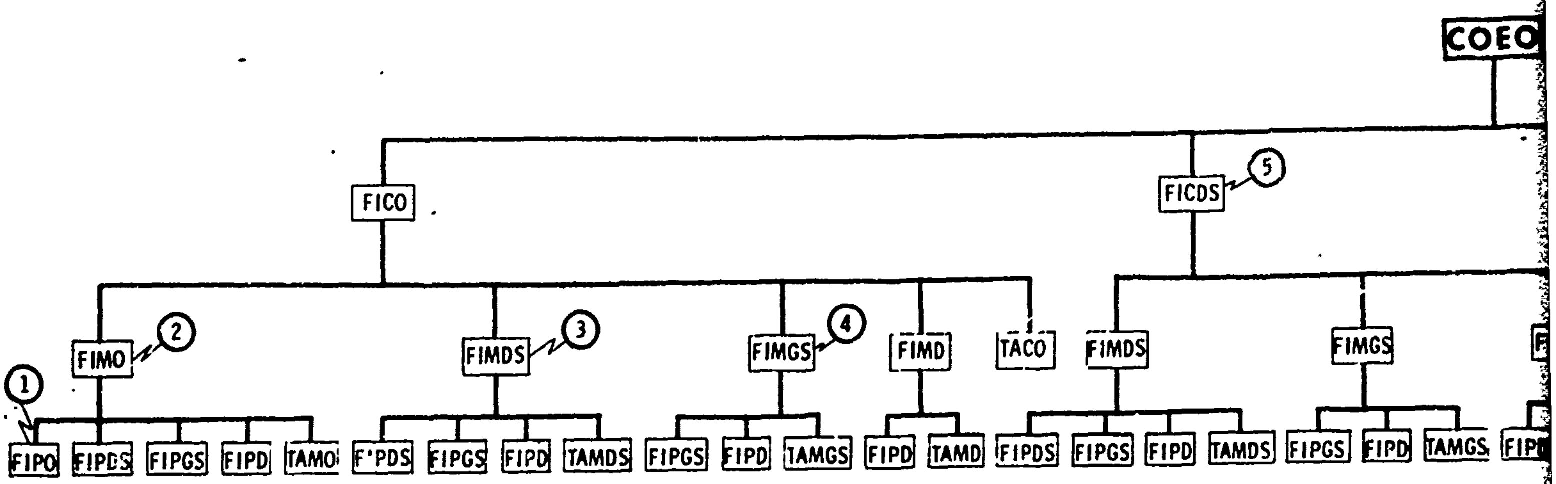
This chapter attempts to familiarize the reader with the manner in which calculations are performed by the model. In order to accomplish this a figure is included that illustrates the various maintenance policies that are capable of evaluation by GEMM (Figure 4). Figure 4 exhibits four maintenance actions: COE (checkout of equipment), FIC (fault isolate to component), FIM (fault isolate to module) and FIP (fault isolate to part). All Checkout of Equipment (COE), is assumed to be performed at the organizational repair level (O). The other three repair actions can be performed at any one of four levels: Organizational (O), Direct Support (DS), General Support (GS), and the Depot (D). Also included in the figure are the throwaway maintenance functions: Throwaway Equipment (TAE), Throwaway Component (TAC), and Throwaway Module (TAM).

In addition to this figure a logic flow diagram of the calculation process is presented in Figure 5. The flow chart is essentially self-explanatory, therefore, detailed discussion of the flow chart will not be presented herein. However, a summary of the calculation process will be presented below to provide a general understanding of the calculation logic prior to study of the flow diagram.

The Principle of Optimality states "An optimal policy has the property that whatever the initial decision, the remaining decisions must constitute an optimal policy with respect to the results of the first decision." This is to say that in a problem constituted of a number of discrete parts, an optimum answer for the totality can be built up if an optimum answer is obtained for each separate part. Applying this principle to Figure 4 forms the basis for GEMM's calculation process. A determination is made of the optimum repair level for each module under a particular FIM. This constitutes the first decision and it is an optimal decision.

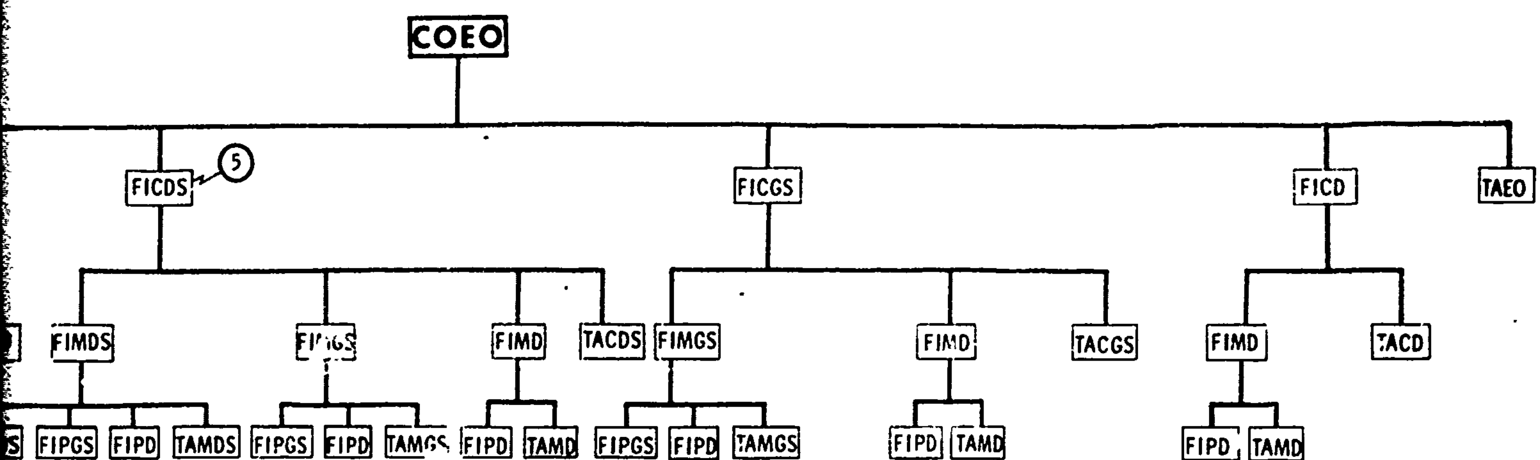
The optimal FIM level is then determined for all components under a particular FIC using the information calculated previously for the optimal repair of the module. This procedure is repeated under each FIC. Finally the optimal location for the FIC function is determined utilizing all of the information that has now been determined (information on the optimal FIM level for components and the optimal FIP levels for the modules). The requirements for performing COEO are then determined and combined with all previous results. An optimal maintenance philosophy has now been determined. This optimal philosophy will specify the level at which all modules and components should be repaired or thrown away.

MAINTENANCE PHI



FIGJRE 4

MAINTENANCE PHILOSOPHY TREE



KEY

CO	-	Check Out	E	-	Equipment	O	-	Organizational Support
FI	-	Fault Isolate	C	-	Component	DS	-	Direct Support
TA	-	Throw-away	M	-	Module	GS	-	General Support
			P	-	Part	D	-	Depot

FIGJRE 4

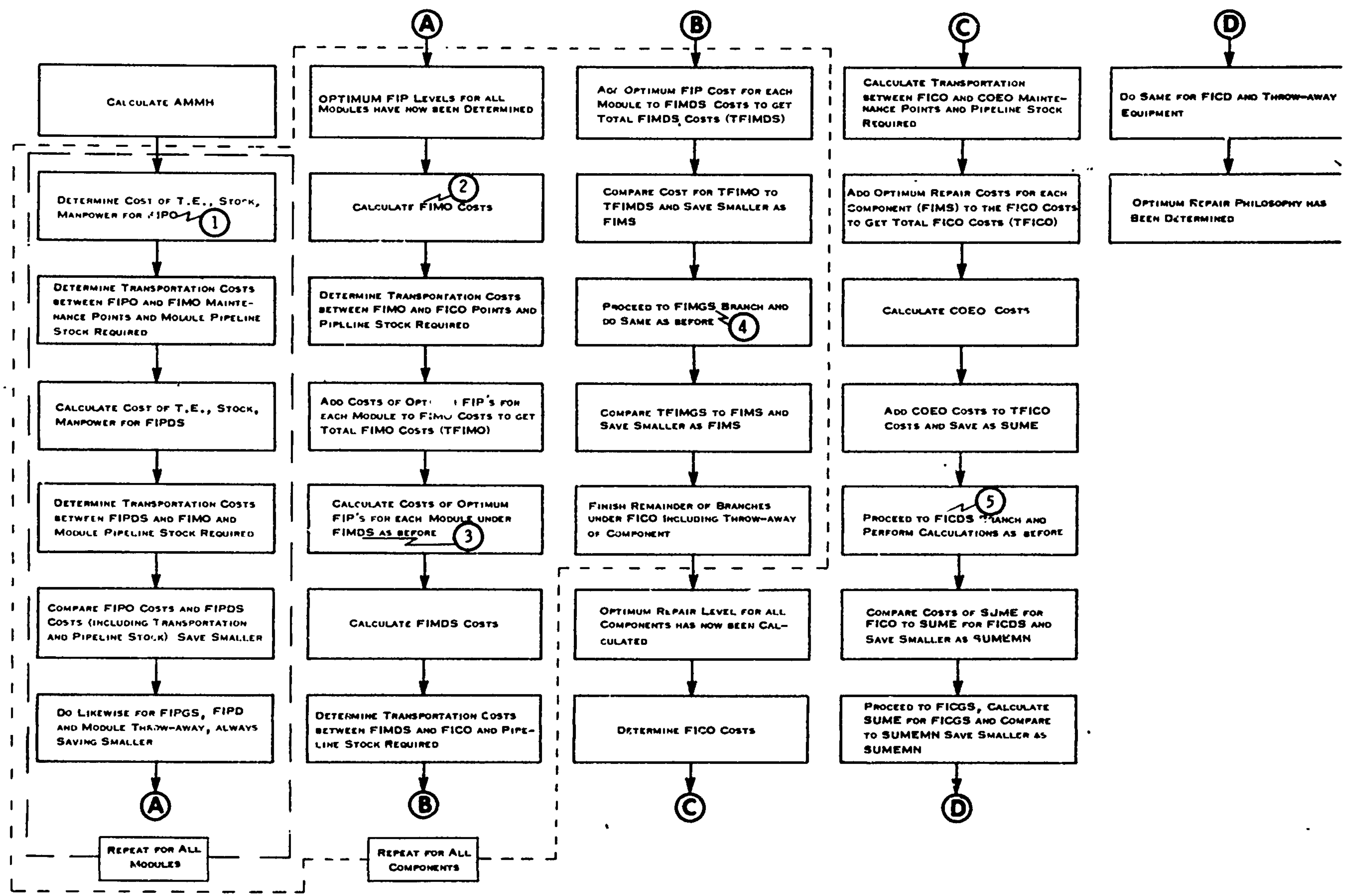


FIGURE 5 **GEMM CALCULATION FLOW LOGIC**

In addition, test equipment, manpower and stockage requirements will be determined for the optimal maintenance philosophy for the equipment under study. These are three general categories of information calculated by GEMM. However, more detailed breakdowns of cost information such as training, inventory management, etc., is also an output of GEMM and will be discussed in the output chapter of this report. To follow the flow logic, Figure 5, it is necessary to refer back to Figure 4. The flow logic refers to Figure 4 from left to right and from bottom to top and also makes reference to specific functions by the use of numbered "flag identifiers".

CHAPTER IV

INPUT & OUTPUT

This chapter discusses the input requirements of GEMM and the output that will be obtained from a computer run. The discussion in this chapter concerning inputs and outputs is general in nature. A more detailed list of input data requirements can be found in Appendix A.

Input

The GEMM model utilizes mean values for inputs in order to reduce the magnitude of the data collection effort. Also, to further minimize data gathering, the number of data inputs is held to the absolute minimum commensurate with the level of detail provided by the GEMM program. Figure 6 indicates the general data requirements for GEMM.

Reliability and Maintainability information is required for the end item and for each component, module and part class within the end item. In order to avoid data collection for individual pieceparts it is necessary to structure the pieceparts into what will be called part classes.

A part class is a means of structuring pieceparts according to some applicable characteristic such as failure rate, cost, weight, etc.. The selection of the particular pieceparts that should make up the parts classes should be done by a research and development engineer. For example, all passive elements might be assigned to a particular part class, say Class 1. There might be twenty-five different pieceparts within this parts class. Each piecepart might be assigned a failure rate and a cost equal to the average of the twenty-five elements of the class. Thus, whenever a piecepart of Class 1 is encountered, the failure rate and cost of Class 1 is used rather than that of the individual piecepart. This will reduce the quantity of input variables required for GEMM. If care and consideration is taken in the structuring of the parts into parts classes, it is felt that the errors introduced will not be significant and the benefits derived, i.e., the substantial reduction in this averaging method does not give sufficient detail for a particular problem then each piecepart can be considered as being a part class itself. If only part failure rates can be determined, then one of the subroutines of GEMM will apportion the reliability parameters to the modules, components and the end item.

The mission profile for the equipment under consideration must be entered into the model. The mission profile includes such information as: hours of operation per day of the equipment, number of days per year of operation, and restrictions on maintenance shops such as number of shifts, hours per shift, etc..

Research and development costs are read into the model as a total cost and may be used to reflect higher research and development costs incurred when higher mean-time-between-failure figures are desired.

* RELIABILITY AND MAINTAINABILITY INFORMATION
* RESEARCH AND DEVELOPMENT COSTS
* MISSION PROFILE
* FORCE STRUCTURE
* TEST EQUIPMENT
* PERSONNEL
* ATTRITION FACTORS
* TRANSPORTATION
* PUBLICATIONS
* STOCKAGE INFORMATION
* ECONOMIC LIFE

Figure 6. Inputs

Force structure information is required such as the number of organizational shops supported by one direct support shops, the number of direct support shops per general support shop, etc. Also distances between shops, and number of equipments supported per shop are other examples of force structure data requirements.

Test equipment and maintenance personnel requirements are needed as input to the model. Test equipment information is input by type and cost and maintenance personnel are described by MOS type and pay allowance per year.

Attrition factors are input to the model to reflect geographical location and peace time or war time conditions. Transportation information includes distances between shops, as mentioned previously, the cost per pound per mile for transportation, and the weights of the modules, components and the end item.

Stockage information includes the array of confidence levels to be investigated, the turnaround times, order-ship times and the length of the replenishment periods.

Also included is the cost of the spares. And, a final input is the economic life to be considered for the equipment under study.

These inputs have been discussed in general categories. Appendix A gives a more detailed listing of input data requirements.

Outputs

One of the most important outputs of GEMM is the operational availability for the equipment being analyzed. This is calculated for the maintenance policy that is determined to be the optimum policy. However, it may be calculated for any of the thirty-five policies.

The Life Cycle Support Costs form an important category of output information. The support costs are divided into the following factors:

(a) Test Equipment Cost

(b) Spares & Repair Parts Cost

(c) Personnel Costs

(d) Transportation Cost

(e) Training Costs

(f) Inventory Management Costs

(g) Publications Cost

(h) Research & Development Costs

(i) Production Cost

The maintenance allocation for repair of all modules, components, and the end item is an output of GEMM. Any module or component that should receive throwaway maintenance is indicated along with the level at which throwaway should take place.

The requirements for stock, test equipment and maintenance personnel is presented in the output. The stockage requirements are shown as the quantity required for each level of maintenance. The test equipment requirements at each level are presented by type of test equipment and quantity required. The MOS designation for the maintenance personnel and the quantity that is required at each level of maintenance is indicated. The outputs for test equipment and personnel are presented on a per shop basis. In addition, the total force structure requirements are also computed.

GEMM also makes use of graphical outputs. Graphs are plotted by the computer to show the inter-relationships of key variables. The relationships that are plotted are listed below:

(a) Availability versus Sensitivity Run (SR)

(b) Support Costs versus Sensitivity Run (SR)

(c) Cost Effectiveness versus Sensitivity Run (SR)

Each sensitivity run may represent the change of one variable or a combination of several variables. Since some variables are not independent, a change in one variable may demand a change in some other variable. For example, if it is desired to determine the effect of a change in the equipment MTBF, this change must be reflected in the component and module MTBFs, the MTTRs, and also in the costs of the equipment.

CHAPTER V

DERIVATION OF KEY EQUATIONS

The following discussion concerns the derivation of key relationships that are utilized internally within the calculation portion of GEMM. The key equations will be presented in the following order: Annual Maintenance Manhour, Test Equipment Requirements, Manpower Requirements, Transportation and Stockage Requirements, Availability, Inventory Management and Training.

Annual Maintenance Manhour Calculations

The Annual Maintenance Manhour computer subroutine is exercised for each module and component and for the equipment to determine the Annual Maintenance Manhour (AMMH) requirements for maintenance. The AMMH is defined as the number of failures per year multiplied by the mean time to repair (MTTR) per failure or,

$$\text{AMMH} = (\text{Number of Failures/year})\ (\text{MTTR/Failure}).$$

In more detail this equation becomes,

$$\text{AMMH} = \frac{(\text{Operating Hours/day X Operating Days/Year})\ (\text{MTTR/Failure})}{\text{Mean-Time-Between Failure (MTBF)}}$$

Test Equipment Calculations

The routine that calculates test equipment requirements makes use of the AMMH information to calculate the test equipment required for each module, component and the equipment. The test equipment required for the Unit Under Test, UUT, whether it be module, component or equipment is defined as the AMMH for the UUT divided by the number of shop hours available per year. In equation form this becomes,

$$\text{Test Equipment of Type I per shop} = \frac{(\text{AMMH of UUT}) \text{ X N}}{\text{Shop Hrs Available/year}},$$

where N = total number of UUT's per shop.

In more detail,

$$\text{TE (I) per shop} = \frac{(\text{AMMH of UUT})\ (\text{UUT's/Shop})}{(\text{Operating Hour/Shop X Operating Days/Year})}$$

and the total test equipment requirement for Type I in the force structure is

Total Test Equipment I = TE (I)/Shop X Number of Shops/Force Structure.

These calculations are performed for the checkout and repair of the equipment being studied and for the repair of each module and component within the equipment. The test equipment requirements are summed over all the UUT's (modules, components and the equipment) to get the total test equipment required for full equipment repair capability.

Maintenance Manpower Calculations

The equations for the calculation of maintenance manpower requirements are derived in a similar manner using the AMMH values for the UUT. In equation form,

$$\text{MOS (I)} = \frac{\text{(AMMH of UUT)}}{\text{(MOS Hours Available)}}$$

or

$$\text{MOS (I) per shop} = \frac{\text{(AMMH of UUT) (UUT's/Shop)}}{\text{(Operating Hrs/Shop x Operating Days/Year X PF)}}$$

where PF = Productivity Factor

The productivity factor indicates the percentage of the time the repairman is productive when he is available.

And for the total force structure this becomes,

Total MOS (I) = MOS (I)/Shop x Number of Shops/Force Structure.

Stockage Calculations

Stockage calculations are based on the Initial Provisioning Manual, TM 38-715-1 for the Initial Provisioning Stock, and on the Consumption rate for Reorder Stock. The model calculates stockage requirements in a similar manner to the way it is now done manually.

There are two types of Initial Provisioning Stockage: Non-repairable stock and repairable stock. Non-repairable stock is stockage for items that are not repaired such as parts and "throwaway" items, i.e., throwaway modules, throwaway components and throwaway equipments. Repairable stock is stockage for items that are repaired such as repairable modules, components and/or end items.

For non-repairable stockage, three classes are calculated for initial provisioning:

(1) Initial Issue Quantity

(2) Order-Ship Quantity

(3) Replacement Quantity

Initial Issue Quantity is the issue of stock that is placed in the field concurrently with the initial deployment of an equipment. Order-Ship Stockage is the stock that is necessary to fill the stockage pipelines and is based on the turnaround time. Finally, the Replacement Quantity is the non-repairable stock located at the depot that is utilized as back-up or replacement stock for the field stockage as it is used up.

For repairable stock there is no need for intial issue stockage or replacement stockage. Since the item in question is repairable, it is not lost to the system when a failure occurs. The only stockage that is required is pipeline stock which is used to replace the failed item while it is being repaired (turned around). This stockage is analogous to Order-Ship Stockage for non-repairables.

The first step in the derivation of the equation to calculate initial issue stock is to determine the number of failures within a 15 day period.

Failures/15 days = Operating Hours/Day x Number of Days/Year

X 0.04 Mean-Time-Between-Failure (MTBF)

This mean demand per shop for the stockage objective (B) is calculated as follows:

Mean Demand = Failures/15 days x Number of Uses/Equipment

X Number of Equipments/Shop x B,

where B = Number of 15 day periods in stockage objective which is defined as the amount of time for which a maintenance level is allowed to stock.

Thus, the stock required for a given protection level (K) at a particular support shop becomes,

$$\text{Initial Issue Stock} = \text{Mean Demand} + K\,(\text{Mean Demand})^{\frac{1}{2}}$$

The total stock required for the entire force structure is therefore,

Initial Issue Stock/Force Structure = Initial Issue/Shop x Number of Shops in Force Structure.

Combining these three types of stockage, the Initial Provisioning Quantity for non-repairables becomes,

Total Initial Provisioning/Force Structure = Initial Issue Stock/Force Structure.

+ Order-Ship/Stock Force Structure.

+ Replacement Stock/Force Structure.

As mentioned previously, only pipeline stockage is required for repairables as compensation for the turnaround time necessary to affect a repair on a failed item. The equation for calculating the Mean Demand for pipeline stockage per shop is

Mean Demand = Failures/15 days x Turnaround Time x Number of uses/Equipment x Number Equipment/Shop.

For a given protection level K, the Pipeline Stockage is

$$\text{Pipeline Stockage Per Shop} = \text{Mean Demand} + K\,(\text{Mean Demand})^{\frac{1}{2}}.$$

The total stock required for the entire force structure is

Pipeline Stockage/Force Structure = Pipeline Stock/Shop x Shops/Force Structure.

Reorder Stockage is calculated for both repairables and non-repairables, and is based on the consumption rate. For non-repairables the Reorder Stockage is equal to the number of failures expected in the force structure and the life cycle plus those failures which will be caused by attrition. Reorder Stockage for repairables is simply the number of failures caused by attrition as all other failures are corrected by repair rather than replacement action.

Availability

GEMM calculates the operational availability of the equipment under consideration at the organizational level. This operational availability is the actual availability of the equipment to the equipment user. The general formula for operational availability, Ao, is:

$$Ao = \frac{\text{Mean Time Between Equipment Failure}}{\text{Mean Time Between Equipment Failure + Mean Equipment Down Time}}.$$

Mean Time Between Equipment Failure is an input to the model while the Mean Down Time of the equipment must be calculated within the model. Mean Down Time (MDT) for the equipment can be stated as:

MDT = (Probability of Equipment Spare on Hand) (Mean Check-out Time of Equipment) + (1 - Probability of Equipment Spare on Hand) (Mean Check-Out Time of Equipment + Turn Around Time for Equipment).

This formula assumes that if an equipment spare is available, it can be obtained in time, t, where t = 0. The Turn Around Time for equipment is the time required to transport the equipment to a maintenance shop for whatever maintenance is required to repair it to its previous operational condition. The only unknown in this equation is the equipment Turn-Around Time (TTE). This variable can be calculated as follows:

TTE = Transportation Time + Waiting Time for Service + (Probability of Component Spare on Hand) (Mean Time To Repair Equipment) + (1 - Probability of Component Spare on Hand)(Mean Time To Repair Equipment + Turn-Around Time for Component).

Once again, the unknown variable is the Turn-Around Time, in this case, the Turn-Around Time for the Component (TTC). This variable is determined in the same manner as TTE. Therefore,

TTC = Transportation Time + Waiting Time for Service + (Probability of Module Spare on Hand) (Mean Time To Repair Component) + (1 - Probability of Module Spare on Hand) (Mean Time To Repair Component + Turn Around Time for Module).

The equation to calculate the Turn-Around Time for the Module (TTM) is

TTM = Transportation + Waiting Time for Service + (Probability of Parts Stock on Hand) (Mean Time To Repair Module) + (1 - Probability of Parts Stock on Hand) (Mean Time To Repair Module + Requisition Time for Part).

In this equation there are no unknowns as the Requisition Time for Parts is an input to the model. The complete equation for Ao is given in Figure 7.

The transportation and waiting time depend on the levels of the respective repair actions and the repair times depend on the module, component, etc., respectively. The Turn-Around Time for parts is a function of the level of parts stockage as would be expected. The GEMM Model considers the variations internally and will yield the operational availability of the equipment to the equipment user.

$$Ao = \frac{MTBF}{MTBF + MDT}$$

and

$$MDT = Pes\ (MCOTE) + (1 - Pes) \left\{ MCOTE + TRANSTE + WTSERE + Pcs\ (MTTRE) + (1 - Pcs) \left[MTTRE + TRANSTC + WTSERC + Pms\ (MTTRC) + (1 - Pms)\ (MTTRC + TRANSTM + WTSERM + Pps\ (MTTRM) + (1 - Pps)\ (MTTRM + REQP)) \right] \right\}$$

where,

Ao = Operational Availability of Equipment to User

MTBF = Mean Time Between Equipment Failure

MDT = Mean Down Time for Equipment

Pes = Probability of Equipment Spare

Pcs = Probability of Component Spare

Pms = Probability of Module Spare

Pps = Probability of Part Spare

MCOTE = Mean Check Out Time for Equipment

MTTRE = Mean Equipment Repair Time

MTTRC = Mean Component Repair Time

MTTRM = Mean Module Repair Time

TRANSTE = Transportation Time of Equipment during maintenance

TRANSTC = Transportation of Component during maintenance

TRANSTM = Transportation Time of Module during maintenance

WTSERE = Waiting Time for Repair Service for Equipment

WTSERC = Waiting Time for Repair Service for Component

WTSERM = Waiting Time for Repair Service for Module

REQP = Requisition Time for Part

FIGURE 7. Operational Availabil:ty Equation

In the case of a throwaway end item, component, or module, the turn-around time of that item would be the time consumed in obtaining a replacement for that item if one were not available at the level where maintenance was being performed.

Inventory Management Calculations

Inventory Management costs for stockage inventories are calculated by the use of an inventory factor. This inventory factor is a percentage of the total stockage costs over the life cycle being considered.

The initial provisioning quantity minus the amount consumed during the initial provisioning period is maintained throughout the life cycle and reorder stock is requisitioned for each year after the initial provisioning period as stock is consumed. An average reorder stockage is considered since the stock is not on hand for the entire period. This average is approximated by one-half of the total reorder stock since theoretically, at the beginning of each year there will be a large quantity of reorder stock on hand and at the end of the year there will be none. Thus, the reorder stock divided by two is the average reorder quantity on hand during the year. The formula yielding the inventory management cost is

Inventory Management Cost for Life Cycle = (Initial Provisioning Quantity - Stock Consumed During Initial Provisioning Period)/2 + Initial Provisioning Stock remaining x the remaining Life Cycle + Reorder Stock/2 x Cost of Stock x Inventory Factor.

Maintenance Training Calculations

Training costs reflect the number of maintenance personnel required, the type of MOS and the turnover rate of maintenance types. The formula for maintenance training is:

Training Costs = Number of MOS type x Cost of Training per MOS type x Life Cycle (years)/Turnover Rate

Publications Cost Calculation

Publications cost are calculated for the check-out equipment, fault-isolate-to-component, fault-isolate-to-module and fault-isolate-to-part maintenance functions. In general,

Publications Cost = Cost per page x Number of pages required for specific maintenance action

Research and Development Cost

This is the total cost of research and development and is an input into the model. It is useful for sensitivity analysis to reflect changes in research and development costs when equipment design and failure rates are changed.

Production Cost

This is simply an estimate of the total production costs including the cost of prime equipment.

Overhaul Costs

Overhaul costs are considered using a time-between-overhaul (TBO) and a cost per overhaul as input information. Overhaul costs may be considered for modules, components and the end-item. The equation for overhaul cost is:

Cost of Overhaul = Equipment Life Cycle/TBO x Cost per Overhaul.

CHAPTER VI

SENSITIVITY ANALYSIS

Purpose

Aside from the maintenance allocation optimization process contained in GEMM, the sensitivity analysis capability of GEMM is its most powerful attribute. Sensitivity analysis has two major uses. The first is to determine the effect of changes in different key variables on support life cycle costs and operational availability. Not only may the effect of one variable be measured, but the effect and interaction of several variables may be studied at one time. This is necessary because the physical variables which are simulated in a support model do not act independently. Though the change of one variable by itself may seem advantageous, it may not be. It is possible that the perturbation of one variable may cause a change in another or several other variables which is detrimental to the system considered as a whole.

Cost Effectiveness

It is for this reason that a sensitivity analysis is performed on reliability and maintainability factors to see what effect different combinations of these factors will have on system costs and effectiveness. This is a tool which allows the system designer or manager to evaluate the effect his decisions will have on costs and effectiveness before they are initiated. Therefore, errors that are made will effect paper exercises and not actual hardware.

Sensitivity of Variables

The second major use for sensitivity analysis is to test the sensitivity of different variables. Unfortunately, design predictions and field data are not one hundred percent reliable. Therefore, it is necessary to know how sensitive a variable is, or how far off an estimate of a variable can be without affecting the solution received by using an estimate of that variable. In other words the risk associated with using a certain value of a variable may be investigated by using sensitivity analysis to determine the changes to system values when a given variable is varied over a range of values. This option allows the system planner to evaluate his decisions armed with the probable outcomes of his decisions if variables do not take on the values his predictions suggest.

Support Parameters

The following support parameters can be varied over a range of values during sensitivity analysis, either separately or in combination with each other:

(a) MTBF's

(b) MTTR's

(c) Cost of Equipment

(d) Test Equipment Information

(e) Manpower Information

(f) Weight of Equipment

(g) Force Structure

(h) Transportation Information

(i) Requisition Times

(j) Operating Hours Per Shop

(k) Stockage Confidence Limits

(l) Attrition Rate

(m) Stockage Objectives & Order-Shipping Time

(n) Economic Life

(o) Training Factors

(p) Inventory Management Factor

(q) Maintenance Policies

(r) Research and Development Cost

(s) Round up Option

(t) Maintenance Publications

(u) Overhaul Considerations

Optimization Under Constraints

The Sensitivity Analysis function of the GEMM Model provides a vehicle for optimization of system parameters under constraints. The GEMM Model itself minimizes support life cycle costs with no constraints.

Using sensitivity analysis it is possible to obtain different combinations of life cycle costs and operational availability for different values

of key system parameters. From these combinations of output it is possible to eliminate combinations of parameters which do not meet operational constraints and to choose that combination of parameters which minimizes or maximizes an objective function subject to the constraints of the problem.

Figure 8 is an example of how this type of optimization may be accomplished using GEMM as a vehicle. By using the sensitivity analysis option of GEMM on stockage confidence levels, a table such as the one in Figure 8 may be obtained. Looking at the values in the table, suppose we are constrained to have a confidence level on stockage of at least 80 percent and a constraint of 93 percent on operational availability. We would like to determine the combination of parameters that would yield the minimum support life cycle costs. In this case, it is policy 3 with life cycle costs equal 4.6 million dollars, confidence limit equal 85 percent, and availability equal to 93 percent. It is possible under another application that policy 4, 5, 6 or 7 might have been least cost and still meet the constraints of the problem.

The example given is a simple one but illustrates how GEMM may be used to optimize under constraints. The number of constraints that may be applied is limited only by the amount of sensitivity analysis which is performed by the model. The number of constraints may range from 0 to a maximum of 54 different types.

The process of optimization under more than one constraint is accomplished in the same manner as one with 1 or 2 constraints, as combinations are eliminated from consideration as soon as any of the constraints are violated. If several combinations meet all constraints, then the least cost combination is chosen as optimum.

POLICY	LIFE CYCLE COST	AVAILABILITY	CONFIDENCE LIMIT
1	1.2	.75	.75
2	3.4	.83	.80
3	$\boxed{4.6}$	.93	.85
4	7.9	.95	.90
5	8.3	.96	.95
6	9.2	.99	.975
7	10.2	.999	.99

Figure 8. Optimization Under Constraints

CHAPTER VII

CONTROL AND DATA CARD ARRANGEMENTS

General

This chapter discusses the card-deck arrangement and input card formats required for operation of the GEMM Model. The deck arrangement discussed herein is for processing on the Borroughs 5500 computer using card input. A detailed step by step input procedure is included which requires no prior data processing knowledge for its use. The process control cards required specifically for the Borroughs machine are not listed but may be obtained from the Computation Agency.

GEMM Card Deck Arrangement

Figure 9 shows the overall card deck arrangement to be used when the GEMM program is run. The GEMM Program Deck is loaded and behind it is placed the Data and Program Control Deck and then the Sensitivity Analysis Deck.

Figure 10 shows the arrangement for the Data and Program Control Deck. The cards are specified by card types and the shaped cards indicate cards which may not necessarily be used depending on the specific use of the GEMM Program.

(1) Card type 1-4 are required.

(2) Card type 5 is a control card.

(3) Card types 6-8 are used if the value of card type 5 is 1, otherwise they are omitted.

(4) Card type 9-42 are required.

(5) Card type 43 is a control card.

(6) Card types 44-46 are used if the value of card type 43 is 1, otherwise they are omitted.

(7) Card type 47 is used if the value of card type 43 is 0.

(8) Card types 48-53 are required.

Figure 11 illustrates the sensitivity variable groups that may be used to perform sensitivity analysis. Any one of these groups or any combination of these groups may make up a sensitivity run. All this means is that after the initial model run, one or several variable values are changed automatically

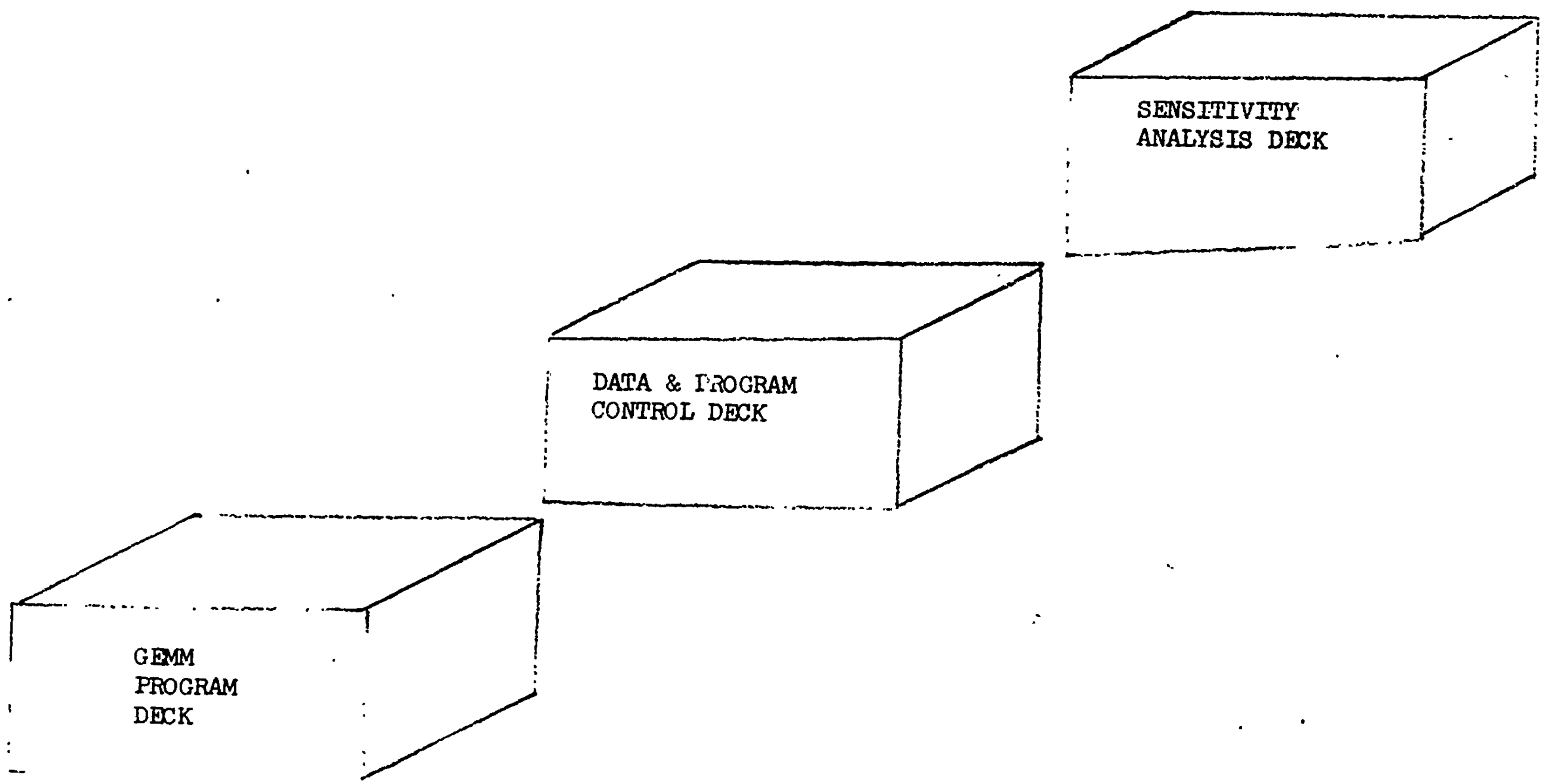


Figure 9. GEMM Card Deck Arrangement

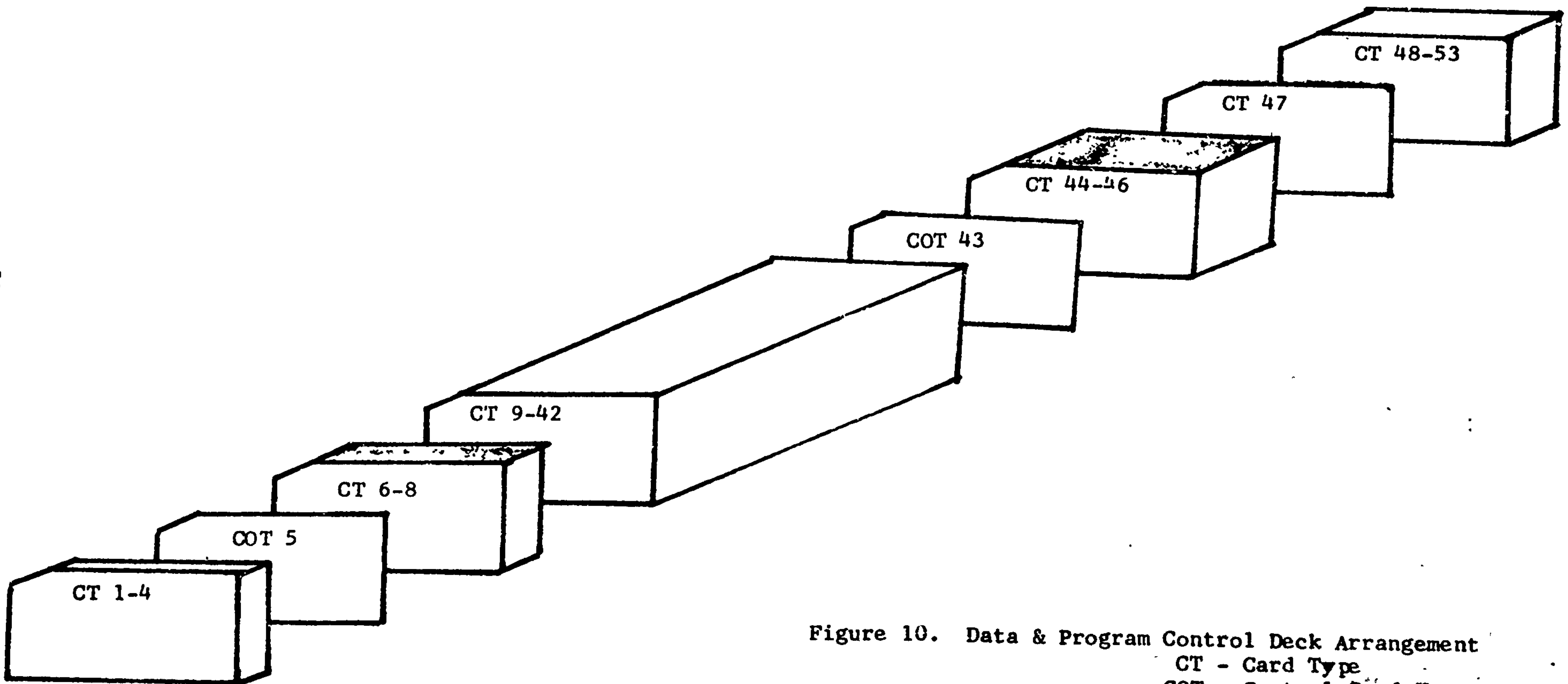


Figure 10. Data & Program Control Deck Arrangement
CT - Card Type
COT - Control Card Type

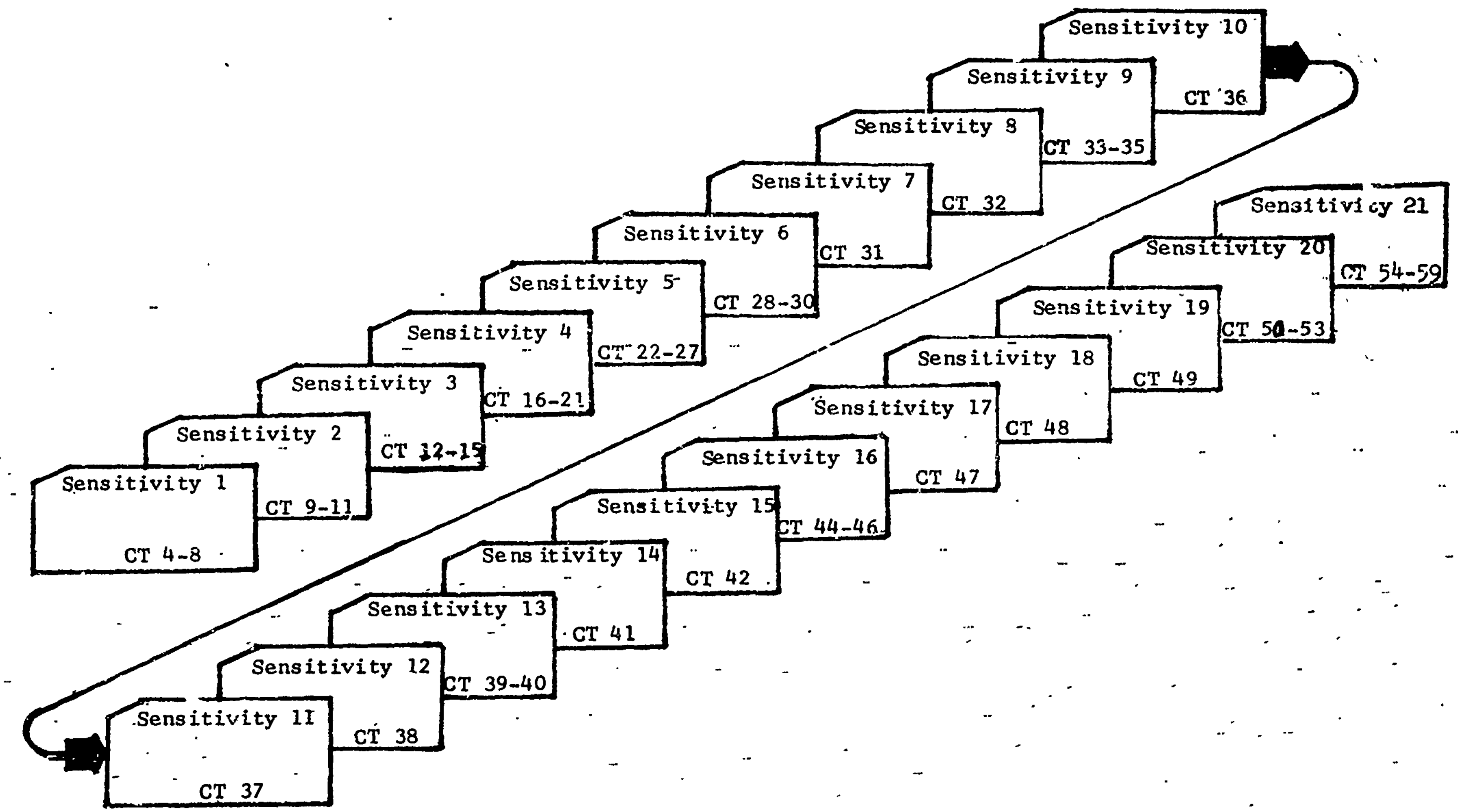


Figure 11. Sensitivity Variable Groups

to determine its effect on life-cycle support costs or operational availability.

If any of the information for any of the sensitivity group is used all the information for that group must be re-read.

Figure 12 shows the deck arrangement for sensitivity analysis. The first card is a control card type 54 containing the number of sensitivity group. The next group of cards are the card types which make up that sensitivity group. If other sensitivity groups are to be changed a type 54 card is required for each followed by the card types to be changed. The next card is a control card type 48 containing a 0 to indicated the end of the sensitivity group cards. These groups of cards (control, sensitivity and control) are repeated for each sensitivity variation desired. The last card of the deck is another control card type 54 containing a 100 to indicate the end of sensitivity variations. If no sensitivity analysis is run the only card in the sensitivity analysis deck is a type 54 card containing the nu er 100. The sensitivity groups are as follows:

Sensitivity 1 - Mean-Time-Between-Failure Information
Sensitivity 2 - Mean-Time-To-Repair Information
Sensitivity 3 - Acquisition Cost Information
Sensitivity 4 - Test Equipment Information
Sensitivity 5 - Manpower Information
Sensitivity 6 - Weight Information
Sensitivity 7 - Force Structure Information
Sensitivity 8 - Transportation Information
Sensitivity 9 - Requisition Times and Waiting Times
Sensitivity 10- Operating Hours Per Shop
Sensitivity 11- Confidence Levels, False-No-Gos, Attrition
Sensitivity 12- Stockage Objectives, Order-Ship Times turnaround times and Reorder Period
Sensitivity 13- Economic Life
Number of Days of Operation of the Equipment and Maintenance Shops, Operating Hours Per Day of Equipment.
Sensitivity 14- Training Cost for Manpower
Sensitivity 15- Inventory and Training Factor
Sensitivity 16- Known Maintenance Allocation Policy
Sensitivity 17- Maintenance Policies
Sensitivity 18- Research and Development Cost
Sensitivity 19- Round Up on Test Equipment and Manpower
Sensitivity 20- Publications Cost
Sensitivity 21- Overhaul Considerations

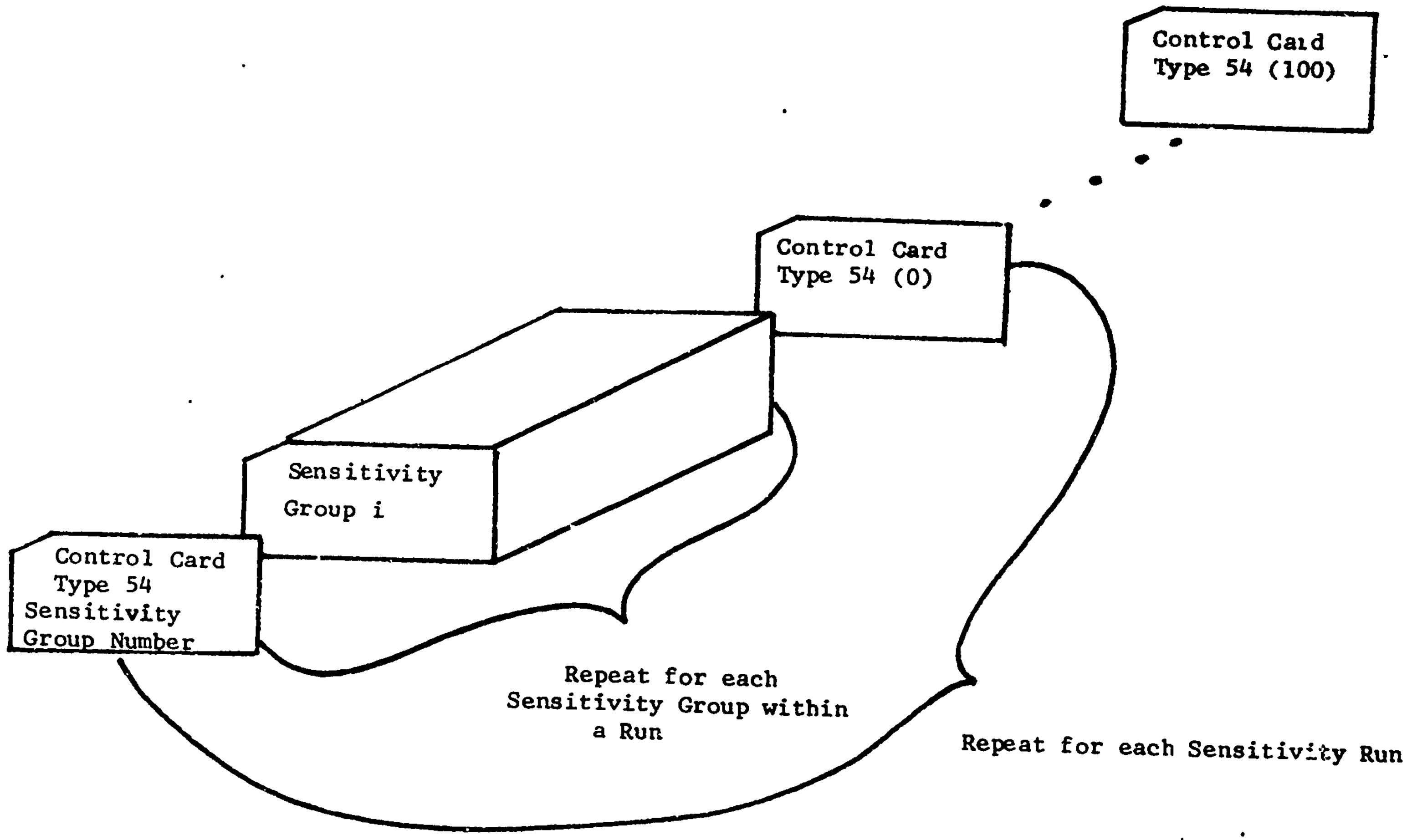


Figure 12. Sensitivity Analysis Deck Arrangement

Data for GEMM Card Types

Distances given are in miles, weight is in pounds and time is in hours unless specified otherwise. The data is as follows in the format indicated:

Type One Card -

Column 1-3 - Number of Components (right justified)
Column 4-6 - Number of Classes of Parts (right justified)

Type Two Card -

Column 1-3 - Number of Modules in Component 1
Column 4-6 - Number of Modules in Component 2

.
.
.

(3 columns for each number, right justified, 10 numbers per card)

Type Three Card -

Column 1-3 - Number of Class 1 parts in Module 1 of Component 1
Column 4-6 - Number of Class 2 parts in Module 1 of Component 1

.
.
.

(Continue for all classes on same card. One card foe each of the modules of Component 1, then all modules of all other components). (Right justified, 20 numbers per card).

Type Four Card -

Column 1-8 - Mean-Time-Between-Failure for Part Class 1.
Column 9-16- Mean-Time-Between-Failure for Part Class 2.

.
.
.

(Continue for each Part Class, right justified with two decimal places, 10 numbers per card).

Type Five Card -

Column 1 - Reliability Assessment Indicator a 1 in column 1 indicates you will read the Type 6, 7, 8 cards. A zero in Column 1 indicates that GEMM will apportion the module, component, and end item mean-time-between-failure numbers. If so skip to card type 9.

Type Six Card -

Column 1-8 - Mean-Time-Between-Failure for Module 1 of Component 1
Column 9-16- Mean-Time-Between-Failure for Module 2 of Component 1

.
.
.

(Continue for each module of component, one card for each component, 10 numbers per card, two decimals).

Type Seven Card -

Column 1-8 - Mean-Time-Between-Failure for Component 1
Column 9-16- Mean-Time-Between-Failure for Component 2

.
.
.

(Continue for all Components) (Right Justified, two decimals 10 numbers per card).

Type Eight Card -

Column 1-10- Mean-Time-Between-Failure of the Equipment (Right Justified, five decimal places.)

Type Nine Card -

Column 1-6 - Mean-Time-To-Check-Out the Equipment
Column 7-12- Mean-Time-To-Repair the Equipment (Right Justified, two decimal places).

Type Ten Card -

Column 1-6 - Mean-Time-To-Repair Component 1
Column 7-12- Mean-Time-To-Repair Component 2

.
.
.

(Continue for all Components, Right Justified, two decimals)

Type Eleven Card -

Column 1-6 - Mean-Time-To-Repair Module 1 of Component 1
Column 7-12- Mean-Time-To-Repair Module 2 of Component 1

.
.
.

(Continue for all Modules of a Component, one card per Component, right justified, two decimals, maximum 10 numbers per card).

Type Twelve Card -

Column 1-8 - Purchase Price of an End Item (Right Justified two decimals)

Type Thirteen Card -

Column 1-8 - Cost of Component 1
Column 9-16- Cost of Component 2

.
.
.

(Continue for all components, ten per card, right justified, two decimals).

Type Fourteen Card -

Column 1-8 - Cost of Module 1 of Component 1
Column 9-16- Cost of Module 2 of Component 1

.
.
.

(Continue for all Modules of Component 1. Repeat with new card for each component, 10 modules per card, right justified, two decimals).

Type Fifteen Card -

Column 1-8 - Cost of Part Class 1
Column 9-16- Cost of Part Class 2

.
.
.

(Continue for all part types 10 per card, right justified, two decimals).

Type Sixteen Card -

Column 1-3 - Number of Different Types of Test Equipment (Right Justified)

Type Seventeen Card -

Column 1 - Punch a 1 if test equipment (TE) type 1 is used to check-out the equipment. Punch a 0 if test equipment type 1 is not used to check-out the equipment.

Column 2 - 1 If TE type 2 is used to check-out the equipment.
0 If TE type 1 is not used to check-out the equipment.

.
.
.
(Continue for all types of TE, with a (1) or (0) for each type, forty numbers per card, maximum)

Type Eighteen Card -

Column 1 - 1 If TE Type 1 used to perform equipment repair.
0 If TE Type 1 not used to perform equipment repair.

Column 2 - 1 If TE Type 2 used to perform equipment repair.
0 If TE Type 2 used to perform equipment repair.

.
.
.
(Continue for all test equipment types 40 per card).

Type Nineteen Card -

Column 1 - 1 If TE Type 1 used to repair Component 1.
0 If TE Type 1 not used to repair Component 1.

.
.
.
(Continue for each type of TE, one card for each component forty numbers per card, maximum).

Type Twenty Card -

Column 1 - 1 If TE Type 1 used to repair Module 1 of Component 1.
0 If TE Type 1 used to repair Module 1 of Component 1.

.
.
.
(Continue for each type of TE one card for each Module of Component 1, then repeat for all components, forty numbers per card, maximum).

Type Twenty-One Card -

Column 1-8 - Cost of Test Equipment Type 1.
Column 9-16- Cost of Test Equipment Type 2.

.
.
.
(Continue for all Test E uipment Types, right justified, two decimals, maximum ten numbers per card).

Type Twenty-Two Card -

Column 1-3 - Number of different types of maintenance personnel (MOS).

Type Twenty-Three Card -

Column 1 - 1 If MOS Type 1 used to Check-Out the Equipment.
0 If MOS Type 1 not used to Check-Out the Equipment.
Column 2 - 1 If MOS Type 2 used to Check-Out the Equipment.
0 If MOS Type 2 not used to Check-Out the Equipment.

.
.
.

(Continue for each Type of MOS, maximum 10 per card).

Type Twenty-Four Card -

Column 1 - 1 If MOS Type 1 used to perform Equipment Repair.
0 If MOS Type 1 not used to perform Equipment Repair.
Column 2 - 1 If MOS Type 2 used to perform Equipment Repair.
0 If MOS Type 2 not used to perform Equipment Repair.

.
.
.

(Continue for all MOS Types, maximum 10 per card).

Type Twenty-Five Card -

Column 1 - 1 If MOS Type 1 used to perform repair on Component 1.
0 If MOS Type 1 not used to perform repair on Component 1.
Column 2 - 1 If MOS Type 2 used to perform repair on Component 1.
0 If MOS Type 2 not used to perform repair on Component 1.

.
.
.

(Continue for each type of MOS Type, one card per component, 10 numbers maximum per card).

Type Twenty-Six Card -

Column 1 - 1 If MOS Type 1 used to repair Module 1 of Component 1.
0 If MOS Type 1 not used to repair Module 1 of Component 1.
Column 2 - 1 If MOS Type 2 used to repair Module 1 of Component 1.
0 If MOS Type 2 not used to repair Module 1 of Component 1.

.
.
.

(Continue for each MOS Type one card for each Module of Component 1, then repeat for all components, right justified, maximum 10 numbers per card).

Type Twenty-Seven Card -

Column 1-8 - Salary for MOS Type 1 at level 1.
Column 9-16- Salary for MOS Type 2 at level 1.

.
.
.

(Continue for each MOS type, right justified, two decimals, maximum 10 numbers per card, repeat with one card for each level 2, 3 and 4).

Type Twenty-Eight Card -

Column 1-7 - Weight of the end item. (Right justified, two decimals).

Type Twenty-Nine Card -

Column 1-7 - Weight of Component 1.
Column 8-14- Weight of Component 2.

.
.
.

(Continue for all components, right justified, two decimals, Maximum 10 numbers per card).

Type Thirty Card -

Column 1-7 - Weight of Module 1 of Component 1.
Column 8-14- Weight of Module 2 of Component 1.

.
.
.

(Continue for all modules of Component 1, one card for each component, right justified, two decimals, maximum 10 numbers per card).

Type Thirty-One Card -

Column 1-4 - Number of Equipment supported by one shop at maintenance level 1.
Column 5-6 - Blank.
Column 7-8 - Number of maintnance shops at Level 1.

.
.
.

(Repeat fields 1-8 starting in column 9 for level 2 thru 4, right justified, all one card).

Type Thirty-Two Card -

Column 1-6 - Average transportation distance between level (L) = 1 and next level (NL) = 1. (Right justified)
Column 7-13- Cost per pound per mile for transportation between level (L) 1 and next level (NL) = 1. (Right justified, four decimals)

.
.
.

(Continue for L equal 2 to 4 with NL equal to 1. Then repeat with NL=2, L=2, 3, 4; then NL=3, L=3, 4; then NL=4, L =4 all on one card).

Type Thirty-Two A Card -

Column 1-7 - Transportation time between level L=(1) and level NL=(1). (Right justified, two decimals).
Column 8-14- Transportation time between L=(1) and NL=(2).
Column 15-21-Transportation time between L=1 and NL=(3).
Column 32-28-Transportation time between L=1 and NL=(4).

.
.
.

(Continue on the same card for L=2, NL=2,3,4; L=3, NL=3,4; L=4, NL=4.)

Type Thirty-Three Card -

Column 1-4 - Requisition time of a part from level (L)=1 to level 4.
Column 5-8 - Requisition time of a module from level (L) = 1 to level 4.
Column 9-12- Requisition time of a component from level (L) = 1 to level 4.

.
.
.

(Repeat with one card for (L) equal to 2, 3, and 4, right justified).

Type Thirty-Four Card -

Column 1-8 - Requisition time of an equipment from level 4, throwaway equipment case (right justified, two decimals).

Type Thirty-Four A Card -

Column 1-8 - Requisition time for an equipment float at organizational level.

Type Thirty-Five Card -

Column 1-4 - Waiting time at level 1 for maintenance.
Column 5-6 - Blank.
Column 7-10- Waiting time at level 2 for maintenance.
Column 11-12-Blank.

.
.
.

(Continue for level 3 and 4, right justified).

Type Thirty-Six Card -

Column 1-5 - Operating Hours per Day of Maintenance Shop at level 1.
Column 6-10- Operating Hours per Day of Maintenance Shop at level 2.

.
.
.

(Continue for level 3 and 4, right justified, two decimals).

Type Thirty-Six A Card -

Column 1-8 - Manpower Productivity Factor, (four decimals, right justified.)

Type Thirty-Seven Card -

Column 1-4 - Number of standard deviations that yields confidence limit desired for part stockage. (Z value, normal distribution).
Column 5-8 - Z value for module stockage.
Column 9-12- Z value for equipment stockage.
Column 13-16-Z value for equipment stockage.
Column 17-20-Confidence limit or safety level (SL) for part stockage.
Column 21-24-(SL) for module stockage.
Column 25-28-(SL) for component stock.
Column 29-32-(SL) for equipment stock.
Column 33-36-Probability of false-no-go at equipment level.
Column 37-40-Attrition factor. (All previous fields right justified, three decimals).
Column 41-43-Requisition objective period in months (right justified, no decimals).

Type Thirty-Eight Card - Number of 15 day periods

Column 1-5 - Stockage objective at level (L) = 1.
Column 6-10- Order ship time at level (L) = 1.
Column 11-15-Turnaround time for modules at level (L) = 1.
Column 16-20-Turnaround time for component at level (L) = 1.

.
.
.

(Repeat with one card for each level (L), right justified, two decimals).

Type Thirty-Nine Card -

Column 1-5 - Economic life of the equipment. (right justified, two decimals, in years).

Type Forty Card -

Column 1-3 - Number of days per year of operation of the equipment (Right justified).
Column 4-6 - Operating hours per day of the equipment. (Right justified no decimals).
Column 7-9 - Numbers of days per year of operation of the maintenance shops (right justified).

Type Forty-One Card -

Column 1-2 - Blank.
Column 3-7 - Cost of training MOS Type 1 (Right justified).
Column 8-9 - Blank.
Column 10-14-Cost of training MOS Type 2.

.
.
.

(Continue for all MOS types, maximum ten numbers per card).

Type Forty-Two Card -

Column 1-5 - Inventory management factor. (Right justified, three decimals).
Column 6-9 - Time between retraining periods for MOS types at level 1. (Right justified, 2 decimals).
Column 10-13-Time between retraining periods at level 2.
Column 14-17-Time between retraining at level 3.
Column 18-21-Time between retraining at level 4.
Column 22-25-Depot maintenance factor.

Type Forty-Three Card -

Column 1 - 1 If you are reading in maintenance allocation.
0 If allocation not read in, skip to type 47.

Type Forty-Four Card -

Column 1 - Level at which fault isolation of components occurs.

Type Forty-Five Card -

Column 1 - Level at which fault isolation for modules of component 1.
Column 2 - Level at which fault isolation for modules of component 2 takes place.

.
.
.
(Continue for all components).

Type Forty-Six Card -

Column 1 - Level at which fault isolation of parts (FIP) of module 1 of component 1 takes place.

Column 2 - Level at which FIP of Module 2 of component 1 takes place.

.
.
.
(Continue for all modules of component 1, repeat with one card for each component).

Type Forty-Seven Card -

Column 1-2 - Number of policies to be analyzed.
Column 3-4 - Number from Figure 3 of a policy to be evaluated.
Column 5-6 - Number from Figure 3 of a policy to be evaluated.

.
.
.
(Continue for all policies to be evaluated, list in ascending order, right justified)

Type Forty-Eight Card -

Column 1-12- Cost of Research & Development, two decimals, right justified

Type Forty-Eight A Card -

Column 1-12- Cost of Production including prime equipment, two decimals, right justified.

Type Forty-Nine Card -

Column 1 - 1 If round up on manpower and test equipment desired.
0 If round up not desired.

Type Fifty Card -

Column 1 - 7 - Cost per page for publications (two decimals, right justified).

Type Fifty-One Card -

Column 1-5 - Number of pages of publications for check-out equipment.
Column 6-10- Number of pages of publications for repair equipment (right justified, no decimals).

Type Fifty-Two Card -

Column 1-5 - Number of pages for repair component 1.
Column 6-10- Number of pages for repair of component 2.

.
.
.

(Continue for all components, maximum 10 to a card, right justified, no decimals).

Type Fifty-Three Card -

Column 1-5 - Number of pages required for repair of module 1, of component 1.
Column 6-10- Number of pages required for repair of module 2, of component 1.

.
.
.

(Repeat for all modules of component 1. Maximum 10 numbers per card, then a new card for each component).

Type Fifty-Four Card -

Column 1-8 - Cost of overhaul for end item (right justified, two decimals).

Type Fifty-Five Card

Column 1-8 - Cost of overhaul for component 1.
Column 9-16- Cost of overhaul for component 2.

.
.
.
(Continue for each component, maximum 10 per card, right justified, two decimals).

Type Fifty-Six Card -

Column 1-8 - Cost of overhaul for module 1 of component 1.
Column 9-16- Cost of overhaul for module 2 of component 1.

.
.
.
(Continue for all modules of component 1, maximum 10 numbers per card, right justified, two decimals. Then repeat for modules of each component).

Type Fifty-Seven Card -

Column 1-3 - Time-between-overhaul of the end item in years (right justified.

Type Fifty-Eight Card -

Column 1-3 - Time between overhaul for component 1.
Column 4-6 - Time between overhaul for component 2.

.
.
.
(Continue for all components (right justified).

Type Fifty-Nine Card -

Column 1-3 - Time between overhaul for module 1 of component 1.
Column 4-6 - Time between overhaul for module 2 of component 1.

.
.
.
(Continue for all modules of component 1. Then repeat for modules of each component.)

Type Sixty Card -

Column 1-3 - 1-20 If sensitivity variable to be exercised. Number indicates which sensitivity variable to be exercised.
0 indicates the last sensitivity variable has been exercised for a run.
100 Indicates end of all use program.

CHAPTER VIII

SAMPLE PROBLEMS

The sample problems included in this report are designed to give the model user an idea of type of model outputs which may be expected, their form, and possible uses for these outputs as an aid to decision making. These examples may also be used to test the program itself if this is desired.

Example I. Maintenance Allocation

This example illustrates the inputs required by GEMM and the results obtained when GEMM is used to optimize the maintenance allocation of an equipment/system based on fixed inputs. The equipment being analyzed is hypothetical and all of the data herein is for illustration purposes only.

The inputs required are listed below.

Type 1. Number of components = 2
Number of classes of parts = 2

Type 2. Number of modules in component (1) = 2
Number of modules in component (2) = 2

Type 3. Number of part type (1) in module (1, 1) = 2
Number of part type (2) in module (1, 1) = 2
Number of part type (1) in module (1, 2) = 0
Number of part type (2) in module (1, 2) = 10
Number of part type (1) in module (2, 1) = 5
Number of part type (2) in module (2, 1) = 0
Number of part type (1) in module (2, 2) = 10
Number of part type (2) in module (2, 2) = 10

Type 4. MTBF for part class (1) = 200,000 hours
(2) = 300,000 hours

Type 5. MTBF Identifier = 0 (MTBF's apportioned)

Type 6, 7, 8 not used.

Type 9. MTTR Equipment = 1.32 hours

Meantime to Check-Out Equipment = 2 hours.

Example I (Contd)

Type 10.	MTTR of component (1) = 1.33 hours
	MTTR of component (2) = 1 hour
Type 11	MTTR of module (1, 1) = 1 hour
	MTTR of module (1, 2) = 2 hours
	MTTR of module (2, 1) = 4 hours
	MTTR of module (2, 2) = 3 hours
Type 12.	Cost of Equipment = $5000
Type 13.	Cost of component (1)= $2000
	(2)= $3000
Type 14.	Cost of module (1, 1) = $1000
	(1, 2) = $1000
	(2, 1) = $1000
	(2, 2) = $1000
Type 15.	Cost of part type (1) = $5
	Cost of part type (2) = $10
Type 15.	Number of test equipment = 3
Type 17.	Test equipment types for checkout = 1 and 3
Type 18.	Test equipment types for repair of equipment = 1
Type 19.	Test equipment types for repair of component (1) = 1 and 3
	Test equipment types for repair of component (2) = 1 and 2
Type 20.	Test equipment types for repair of module (1, 1) = 3
	Test equipment types for repair of module (1, 2) = 1
	Test equipment types for repair of module (2, 1) = 1
	Test equipment types for repair of module (2, 2) = 2
Type 21.	Cost of Test Equipment type (1) = $1000
	(2) = $700
	(3) = $200
Type 22.	Number of Manpower types = 3
Type 23.	Manpower types for check-out equipment = 1
Type 24.	Manpower types for repair of equipment = 2
Type 25.	Manpower types for repair of component (1) = 1 and 2
	Manpower types for repair of component (2) = 3
Type 26.	Manpower types for repair of module (1, 1) = 1 and 2
	Manpower types for repair of module (1, 2) = 1
	Manpower types for repair of module (2, 1) = 3
	Manpower types for repair of module (2, 2) = 3
Type 27.	Salary of manpower type (1) = $8000
	Salary of manpower type (2) = $10000
	Salary of manpower type (3) = $8000
	These remain the same for all four levels.
Type 28.	Weight of equipment = 1000 lbs.
Type 29.	Weight of component (1) = 500 lbs.
	Weight of component (2) = 500 lbs.
Type 30.	Weight of module (1, 1) = 200 lbs.
	Weight of module (1, 2) = 300 lbs.
	Weight of module (2, 1) = 300 lbs.
	Weight of module (2, 2) = 200 lbs.

Example I. (Contd)

Type 31. Number of equipment supported at level (1) = 125
Number of maintenance shops at level (1) = 8
Number of equipment supported at level (2) = 250
Number of maintenance shops at level (2) = 4
Number of equipment supported at level(3) = 500
Number of maintenance shops at level (3) = 2
Number of equipment supported at level (4) = 1000
Number of maintenance shops supported at level (4) = 1

Type 32. Transportation distance (1, 1) = 0 miles
Transportation distance (1, 2) = 20 miles
Transportation distance (2, 1) = 100 miles
Transportation distance (2, 2) = 400 miles
Transportation distance (2, 3) = 80 miles
Transportation distance (2, 4) = 350 miles
Transportation distance (3, 3) = 0 miles
Transportation distance (3, 4) = 300 miles
Transportation distance (4, 4) = 0 miles
Cost-per-pound-mile (1, 1) = \$.000
Cost-per-pound-mile (1, 2) = \$.0001
Cost-per-pound-mile (1, 3) = \$.0001
Cost-per-pound-mile (1, 4) = \$.0001
Cost-per-pound-mile (2, 2) = \$.000
Cost-per-pound-mile (2, 3) = \$.0001
Cost-per-pound-mile (2, 4) = \$.0001
Cost-per-pound-mile (3, 3) = \$.000
Cost-per-pound-mile (3, 4) = \$.0001
Cost-per-pound-mile (4, 4) = \$.000

Type 32A. Transportation Time (1, 1) = 0 hours
Transportation Time (1, 2) = 5 hours
Transportation Time (1, 3) = 10 hours
Transportation Time (1, 4) = 240 hours
Transportation Time (2, 2) = 0 hours
Transportation Time (2, 3) = 10 hours
Transportation Time (2, 4) = 240 hours
Transportation Time (3, 3) = 0 hours
Transportation Time (3, 4) = 240 hours
Transportation Time (4, 4) = 0 hours

Type 33. Requisition time for parts from level (4) to level (1) = 720 hrs
Requisition time for parts from level (4) to level (2) = 480 hrs
Requisition time for parts from level (4) to level (3) = 240 hrs
Requisition time for parts from level (4) to level (4) = 48 hrs
Requisition time for modules from level (4) to level (1) = 720 hours
Requisition time for modules from level (4) to level (2) = 480 hours
Requisition time for modules from level (4) to level (3) = 240 hours
Requisition time for modules from level (4) to level (4) = 48 hrs

Example 1. Contd

Requisition time for components from level (4) to level (1) = 720 hours
Requisition time for components from level (4) to level (2) = 480 hours
Requisition time for components from level (4) to level (3) = 240 hours
Requisition time for components from level (4) to level (4) = 48 hours

Type 34. Requisition time for equipment from level (4) to level (1) = 720 hours

Type 34A. Requisition time of an equipment float = 2 hours

Type 35. Waiting time for maintenance at level (1) = 2 hours
Waiting time for maintenance at level (2) = 4 hours
Waiting time for maintenance at level (3) = 6 hours
Waiting time for maintenance at level (4) = 8 hours

Type 36. Operating hours per shop, level (1) = 5 hours
Operating hours per shop, level (2) = 5 hours
Operating hours per shop, level (3) = 10 hours
Operating hours per shop, level (4) = 10 hours

Type 36A. Productivity factor = .75

Type 37. Confidence limits = 95% value = 1.65
Probability of false no-gos = 5%
Attrition factor = 5%
Requirements Objective Period = 12 months

Type 38. Stockage objective period at level (1) = 1
Stockage objective period at level (2) = 2
Stockage objective period at level (3) = 2
Stockage objective period at level (4) = 3
Order shipping time at level (1) = 1
Order shipping time at level (2) = 2
Order shipping time at level (3) = 2
Order shipping time at level (4) = 3
Turnaround time for modules at level (1) = .5
Turnaround time for modules at level (2) = .5
Turnaround time for modules at level (3) = 1
Turnaround time for modules at level (4) = 1
Turnaround time for components and equipment at level (1) = .5
Turnaround time for components and equipment at level (2) = .5
Turnaround time for components and equipment at level (3) = 1
Turnaround time for components and equipment at level (4) = 1

Type 39. Economic life = 10 years

Type 40. Number of days per year of operation of maintenance shops = 365 days
Number of operating hours per day of the equipment = 8 hours
Number of days per year of operation of the equipment = 365 days

Example 1. Contd

Type 41. Cost to train manpower type (1) = \$1000
Cost to train manpower type (2) = \$1000
Cost to train manpower type (3) = \$1000
Type 42. Training factor = 2.5 years for levels 1 - 3 and 5 years for level 4
Inventory factor =.01
Depot maintenance factor = .30
Type 43. Known allocation identifier = 0
Type 44. Not required.
Type 45. Not required.
Type 46. Not required.
Type 47. MMAX = 4
Policies 8, 9, 21, 25
Type 48. Research and Development Cost = \$1,000,000
Type 49. Round up equals 0.
Type 50. Cost per page for publications = \$150.
Type 51. Number of pages for check-outs = 15 pages.
Number of pages for FIC = 20 pages.
Type 52. Number of pages for FIM for each component = 15 pages.
Type 53. Number of pages for FIP of each module = 15 pages.
Type 54. Cost of overhaul of equipment = \$400.
Type 55. Cost of overhaul of component 1 = \$0
Cost of overhaul of component 2 = \$0
Type 56. Cost of overhaul of module 1 of component 1 = \$0
Cost of overhaul of module 2 of component 1 = \$0
Cost of overhaul of module 1 of component 2 = \$0
Cost of overhaul of module 2 of component 2 = \$0
Type 57. Time between overhaul for equipment = 4 years
Type 58. Time between overhaul for component 1 = 50 years
Time between overhaul for component 2 = 50 years
Type 59. Time between overhaul for module 1 of component 1 = 50 years
Time between overhaul for module 2 of component 1 = 50 years
Time between overhaul for module 1 of component 2 = 50 years
Time between overhaul for module 2 of component 2 = 50 years
The fifty year figure is used to assure no overhaul will take place.
Type 60. Sensitivity variable = 100 (no sensitivity)

NOTE: For this example MTBF's are apportioned by the model and are not read in. Also, since type 60 input is 100, there is no sensitivity analysis required.

Using these inputs we are manipulating the GEMM Model to simulate the operation of this equipment for its entire life cycle. In this case, we are using the GEMM Model to determine the best maintenance policy for the equipment to follow from the set of possible maintenance policies listed in the inputs based on life cycle support costs. The equipment may follow any

one of these policies or a combination of any of these policies.

In this example, we are looking at a policy which reflects maintenance support positive, a throw-away module philosophy, a four-level philosophy and a throw-away component philosophy. It is very possible that the best equipment philosophy may be one in which some modules may be repaired in the field, some in the depot and others may be thrown away.

The first output from the GEMM Model is the input information. This allows the user to check his input data and provides a record of the input parameters for this run. The data is listed by its variable name in the program. See Table I.

The next output is the reliability apportionment (Table II). Only part failure rates were input in this example and the program apportioned the failure rates, in a series manner, to the modules, components, and the end item.

The next output is the maintenance allocation for the equipment, its components and modules (Table III). Here, fault isolation to components is carried out at level (1). Component 1 and 2 are fault isolated to the module at level (2). In this case, all modules are fault isolated to the part level at level (4). For this example, level (1) is the organizational level of support, level (2) is direct support, level (3) is general support, and level (4) is the depot level of support. This is the least cost maintenance allocation based on the input data.

The next output is a break-out or the life cycle support costs for the best maintenance allocation and the Operational Availability of the equipment (Table IV). Research and development and production costs were read into the model. Test equipment costs, manpower cost and training cost are based only on that percentage of resource which is used for the equipment under consideration. It may be possible that a resource is not used fully at some given level. If so, only a percentage of the cost of that resource is charged to the equipment under study. Stockage and inventory costs are for the entire life-cycle. The operational availability figure is the expected availability of the equipment to the user in the field.

The next output is stockage information. Table V shows the different types of stockage required for the maintenance allocation chosen by GEMM. It is broken-out into four types, parts, modules, components, and end-item stock. Under each type, it is further divided to indicate the type, cost and level at which each repairables or non-repairables will be stocked. The quantities listed are for the entire force structure based on the force structure information input to the model. These are the initial provisioning quantities. Reorder stock is simply based on demand.

Table I. INPUT INFORMATION

```
NC=  2NCLASP=  2
NMK(COMPONENT)=  2  2
NUMBR(COMP,MODULE,CLASS)= 70 50
NUMBR(COMP,MODULE,CLASS)= 70 50
NUMBR(COMP,MODULE,CLASS)= 70 50
NUMBR(COMP,MODULE,CLASS)=140100
MTBFP(CLASS)= 200000.00 300000.00
MTBFID= 0
MTTRCE=  2.00MTIME=  1.32
MTTRC(COMP)=  1.33  1.00
MTTRM(COMP,MODULE)=        1.00        2.00
MTTRM(COMP,MODULE)=        4.00        3.00
CSET= 5000.00
CCC(COMP)= 2000.00 3000.00
CC(COMP,MODULE)= 1000.00 1000.00
CC(COMP,MODULE)= 1000.00 2000.00
C(CLASS)=     5.00    10.00
NTE=  3
TECF(TYPE)=101
TEET(TYPE)=100
TECT(COMP,TYPE)=101
TECT(COMP,TYPE)=110
TEMT(COMP,MODULE,TYPE)=001
TEMT(COMP,MODULE,TYPE)=100
TEMT(COMP,MODULE,TYPE)=100
TEMT(COMP,MODULE,TYPE)=010
TECOST(TYPE)= 1000.00  700.00  200.00
NMOS=  3
MOSCE(TYPE)=100
MOSE(TYPE)=010
MOSC(COMP,TYPE)=110
MOSC(COMP,TYPE)=001
```

TABLE I. INPUT INFORMATION (Contd)

```
MOSM(COMP,MODULE,TYPE)=110
MOSM(COMP,MODULE,TYPE)=100
MOSM(COMP,MODULE,TYPE)=001
MOSM(COMP,MODULE,TYPE)=001
MCOST(TYPE)= 8000.0010000.00 8000.00
MCOST(TYPE)= 8000.0010000.00 8000.00
MCOST(TYPE)= 8000.0010000.00 8000.00
MCOST(TYPE)= 8000.0010000.00 8000.00
WTE=     1000.00
WTC(COMP)= 500.00 500.00
WTM(COMP,MODULE)= 200.00 300.00
WTM(COMP,MODULE)= 300.00 200.00
NSHOP(LEVEL)= 125. 250. 500.1000.
NUMFS(LEVEL)=  8  4  2  1
TRANST(LEVEL,NEXT LEVEL)=     0.     20.    100.    400.
  0.     80.    350.     0.    300.     0.
TRANS(LEVEL,NEXT LEVEL)=    0.00    5.00   10.00 240.00    0.00
 10.00 240.00    0.00 240.00    0.00
COSLB(LEVEL,NEXT LEVEL)=0.0001000.0001000.0001000.000100
 0.0001000.0001000.0001000.0001000.000100
REQPT(LEVEL,4)720.REQMT(LEVEL(4)720.REQCT (LEVEL,4)720.
REQPT(LEVEL,4)480.REQMT(LEVEL(4)480.REQCT (LEVEL,4)480.
REQPT(LEVEL,4)240.REQMT(LEVEL(4)240.REQCT (LEVEL,4)2[illegible]
REQPT(LEVEL,4) 48.REQMT(LEVEL(4) 48.REQCT (LEVEL,4) 48.
REQET=    720.
REQ=      2.00
WAIT(LEVEL)=     2.
WAIT(LEVEL)=     4.
WAIT(LEVEL)=     6.
```

TABLE I. INPUT INFORMATION (Contd)

```
WAIT(LEVEL)=     8.
OPHRSH(LEVEL)= 5.00 5.0010.0010.00
PRODUCTIVE FACTOR=  0.7500
K1= 1.65K2= 1.65K3= 1.65XK4= 1.65TK1= 0.95TK2= 0.95TK3= 0.95
    TK4= 0.95 PFNGO= 0.05ATRF= 0.05ROP=12.
B(LEVEL)= 1.00G(LEVEL)= 1.00TURN1(LEVEL)= 0.50TURN2(LEVEL)= 0.50
B(LEVEL)= 2.00G(LEVEL)= 2.00TURN1(LEVEL)= 0.50TURN2(LEVEL)= 0.50
B(LEVEL)= 2.00G(LEVEL)= 2.00TURN1(LEVEL)= 1.00TURN2(LEVEL)= 1.00
B(LEVEL)= 3.00G(LEVEL)= 3.00TURN1(LEVEL)= 1.00TURN2(LEVEL)= 1.00
LLIFE=10.00
NDAY=365OPHRDY= 8.NDAE=365
XMAN(MOS)=   1000.   1000.   1000.
FACTIN= 0.1700TRAIN(LEVEL)=  2.50  2.50  2.50  5.00DMF=  0.30
KNOWN=  0
POLICIES     8 92125
RESEARCH AND DEVELOPMENT COST     1000000.00
PRODUCTION CUST=   5000000.00
ROUND UP  EQUAL 0
PPC=  150.00
PGC= 15.00PGL= 20.00
PGM(COMP)= 15.00 15.00
PGP(COMP,MODULE)= 15.00 15.00
PGP(COMP,MODULE)= 15.00 15.00
CTOE=    400.00
CTOC(COMP)=        0.00       0.00
CTOM8COMP,MOD)=        0.00       0.00
CTOM8COMP,MOD)=        0.00       0.00
TBOE=   4.00
TBOC(COMP)= 50.00 50.00
TBOM(COMP,MOD)= 50.00 50.00
TBOM(COMP,MOD)= 50.00 50.00
```

TABLE II. RELIABILITY INFORMATION

ITEM	MEAN TIME BETWEEN FAILURE
END ITEM	287.097
COMPONENT 1	967.742
COMPONENT 2	645.161
MODULE 1, 1	1935.484
MODULE 1, 2	1935.484
MODULE 2, 1	1935.484
MODULE 2, 2	967.742
PART TYPE 1	200000.
PART TYPE 2	300000.

TABLE III. MAINTENANCE ALLOCATION

	COMP	MOD	FIC	FIM	FIP
	1			2	
	1	1			4
	1	2			4
	2			2	
	2	1			4
	2	2			4

TABLE IV. LIFE CYCLE COSTS

R AND D COST	1000000.00
PRODUCTION COST	5000000.00
TEST EQUIPMENT	25239.79
STOCKAGE	
INITIAL PROVISIONING	1008888.00
REORDER STOCK	13492590.00
TOTAL STOCK	14501478.00
MANPOWER	2731361.78
TRAINING	117970.84
INVENTORY	355053.95
TRANSPORTATION	710280.00
PUBLICATION	18750.00
OVERHAUL COST*	800000.00
TOTAL LIFE CYCLE COST	25260134.36
OPERATIONAL AVAILABILITY	0.9910

TABLE V. STOCKAGES

PARTS STOCKAGE

LEVEL	CLASS	QUANTITY	COST
1	1	0.	0.00
1	2	0.	0.00
2	1	0.	0.00
2	2	0.	0.00
3	1	0.	0.00
3	2	0.	.00
4	1	6216.	31078.00
4	2	2981.	29810.00

MODULE STOCKAGE

COMPONENT	MODULE	LEVEL	STOCK	COST
1	1	1	0.	0.00
1	2	1	0.	0.00
2	1	1	0.	0.00
2	2	1	0.	0.00
1	1	2	52.	52000.00
1	2	2	52.	52000.00
2	1	2	52.	52000.00
2	2	2	88.	176000.00
1	1	3	0.	0.00
1	2	3	0.	0.00
2	1	3	0.	0.00
2	2	3	0.	0.00
1	1	4	0.	0.00
1	2	4	0.	0.00
2	1	4	0.	0.00
2	2	4	0.	0.00

TABLE V. STOCKAGES (Contd)

COMPONENT STOCKAGE

COMPONENT	LEVEL	STOCK	COST
1	1	104.	208000.00
2	1	136.	408000.00
1	2	0.	0.00
2	2	0.	0.00
1	3	0.	0.00
2	3	0.	0.00
1	4	0.	0.00
2	4	0.	0.00

END ITEM STOCKAGE

LEVEL	STOCK	COST
1	0.	0.00

In this example, initial issue and order-ship part stock is required at level 4 where FIP is performed. Replacement stock is also required at level (4). Module stock is required at level (2) where FIM maintenance is performed. Since COE and FIC are accomplished at the same level no end item float is required.

The next output is Test Equipment. Table VI lists the type, quantity and cost of test equipment required at each level of maintenance. Also listed are the requirements for test equipment in the whole force structure.

Note that no test equipment is required at the general support level since no maintenance performed at this level. Also the values listed under "quantity" are the percentages of the test equipment which is used by the equipment being evaluated. If this equipment is the only equipment using the test equipment, these numbers must be rounded up to the nearest whol number. A type 49 card with a value of 1 would cause both test equipment and manpower requirements to be rounded up. The information listed under "Total Test Equipment Requirements" is for the entire force structure. Again, if the equipment is the only one to use these test equipment, the quantity values on a per shop basis must be rounded up and multiplied times the number of each shop in the force structure.

The last output for this example is maintenance personnel. Table VII shows type quantity and cost of the different manpower categories. The costs here is on a per year basis. Again the quantity and cost information are based on use chargeable directly to the equipment under consideration. Also, as with the test equipment, "Total Maintenance Personnel Requirements" are based requirements for the total force structure.

The last two outputs, one graphical and one table of cost, availability and cost-effectiveness are not used for this example since there is no sensitivity analysis performed.

TABLE VI. TEST EQUIPMENT PER SHOP

ORGANIZATIONAL SUPPORT*

TYPE	QUANTITY	COST
1	1.715	1715.33
2	0.000	0.00
3	1.033	206.67

DIRECT SUPPORT*

TYPE	QUANTITY	COST
1	1.170	1169.73
2	0.620	434.00
3	0.550	109.95

GENERAL SUPPORT*

TYPE	QUANITY	COST
1	0.000	0.00
2	0.000	0.00
3	0.000	0.00

DEPOT SUPPORT*

TYPE	QUANITY	COST
1	1.736	1736.00
2	1.736	1215.20
3	0.289	57.87

TOTAL TEST EQUIPMENT REQUIREMENTS

TYPE	QUANTITY
1	20.138
2	4.216
3	10.755

TABLE VII. MAINTENANCE PERSONNEL PER SHOP

ORGANIZATIONAL SUPPORT"

MOS	QUANTITY	COST
1	1.378	11022.22
2	0.909	9093.33
3	0.000	0.00

DIRECT SUPPORT"

MOS	QUANTITY	COST
1	0.733	5863.82
2	0.733	7329.78
3	0.827	6613.33

GENERAL SUPPORT"

MOS	QUANTITY	COST
1	0.000	0.00
2	0.000	0.00
3	0.000	0.00

DEPOT SUPPORT"

MOS	QUANTITY	COST
1	0.868	6944.00
2	0.289	2893.33
3	2.893	23146.67

TOTAL MAINTENANCE PERSONNEL REQUIREMENTS

MOS,	QUANTITY
1	14.822
2	10.496
3	6.200

Example 2, Maintainability vs. Reliability Tradeoff

The input data for our hypothetical equipment is identical to that used in Example 1. In this example we are interested in knowing the effect changes in Reliability and Maintainability have on support life cycle costs and operational availability.

To accomplish this we employ the sensitivity analysis option of GEMM. In this case, we will make four sensitivity runs perturbing each time: the mean-time-between-failure (MTBF) of parts, the mean-time-to-repair (MTTR) of the equipment, components and modules, and also the acquisition cost of the equipment, components, modules and parts.

Table VIII shows the values over which these parameters are varied. For each sensitivity run there is a set of parameter values. These sets of values may be thought of as the parameter values given by four different contractors vying for a development contract.

TABLE VIII. SENSITIVITY VALUES

PARAMETER	SENSITIVITY 1	SENSITIVITY 2	SENSITIVITY 3	SENSITIVITY 4
MTBF Type 1 Parts	50000 hrs	100000 hrs	200000 hrs	300000 hrs
MTBF Type 2 Parts	75000 hrs	150000 hrs	300000 hrs	400000 hrs
MTTR Checkout Eqpmt	.5 hrs	1.5 hrs	2 hrs	4 hrs
MTTR Equipment	.5 hrs	.75 hrs	1.32 hrs	2.0 hrs
MTTR Component 1	.5 hrs	1.0 hrs	1.33 hrs	3. hrs
MTTR Component 2	.5 hrs	.75 hrs	1.0 hrs	5.0 hrs
MTTR Module (1,1)	.5 hrs	.75 hrs	1.0 hr	2.0 hrs
MTTR Module (1,2)	.5 hrs	1.0 hrs	2.0 hrs	6.0 hrs
MTTR Module (2,1)	2 hrs	3 hrs	4 hrs	8 hrs
MTTR Module (2,2)	1 hrs	2 hrs	3 hrs	4 hrs
Part Cost Type 1	$[illegible].00	$80.00	$5.00	$10.00
Part Cost Type 2	$5.00	$14.00	$10.00	$20.00
Equipment Cost	$2500.00	$3000.00	$5000.00	$15000.00
Component 1 Cost	$1500.00	$1500.00	$2000.00	$5000.00
Component 2 Cost	$1000.00	$1500.00	$3000.00	$10000.00
Module (1,1) Cost	$ 500.00	$5.00	$1000.00	$2000.00
Module(1,2) Cost	$ 500.00	$ 750.00	$1000.00	$2000.00
Module (2,1) Cost	$ 500.00	$ 500.00	$1000.00	$2000.00
Module (2,2) Cost	$1000.00	$1250.00	$2000.00	$4000.00

In this ecample, we are optimizing over the same four policies that we evaluated in Example 1, but this time the optimization is accomplished with the original data and the four groups of sensitivity data. For each set of data the same output is obtained as in Example 1.

Table IX depicts the maintenance allocation for the second sensitivity run. Module one of component one is thrown away at level 2 while all the other modules are repaired at depot level (4). This table illustrates that thru optimization repair of modules of the same component can be allocated to different levels. This versitility in a model is required since one module may be mostly electronic and may be repaired in the field, and another module may be optical in nature and may have to be sent to the depot for repair.

Table X is a summary table which shows for each sensitivity run the life cycle cost, the operational availability and the cost-effectiveness. Cost-effectiveness is defined as availability divided by life cycle cost. This table is useful if a constrained optimum solution is required. In this example policy 1 is the original data, policy is the first sensitivity run and so on for policies 3, 4 and 5.

Suppose there is a constraint on operational availability that it must be greater than 99 percent. This constraint would eliminate policies 2 and 3 from consideration. Of the policies remaining, policy 4 is the least cost while meeting the operational availability constraint. The life-cycle cost is $25.26 million and the operational availability is .9909. Policy 4 is also the most cost-effective system. That is, you receive the most availability per unit dollar with policy 4.

The last three outputs, Figure 13, 14 and 15 are graphical outputs. Figure 13 provides a graph of life-cycle cost vs. different sensitivity runs. The first bar is for the original data and the remaining bars are for the sensitivity runs. Cost is in millions of dollars and each dot is one million dollar. Figure 14 is a graph of availability vs. sensitivity run and the last graph is cost-effectiveness where each dot is a unit of cost-effectiveness.

These graphs are designed to give the user a graphical representation of decision factors and to aid the user in any trend analysis.

TABLE IX. MAINTENANCE ALLOCATION FOR SENSITIVITY 2

COMP	MOD	FIC	FIM	FIP
1		1	2	
1	1			0
1	2			4
2			2	
2	1			4
2	2			4

TABLE X. SUMMARY TABLE

POLICY	COST	AVAIL	COST-EFF
1	25.26013	99.099	3.9231
2	41.20918	97.352	2.3624
3	30.40519	98.510	3.2399
4	25.26013	99.099	3.9231
5	39.68797	99.214	2.4999

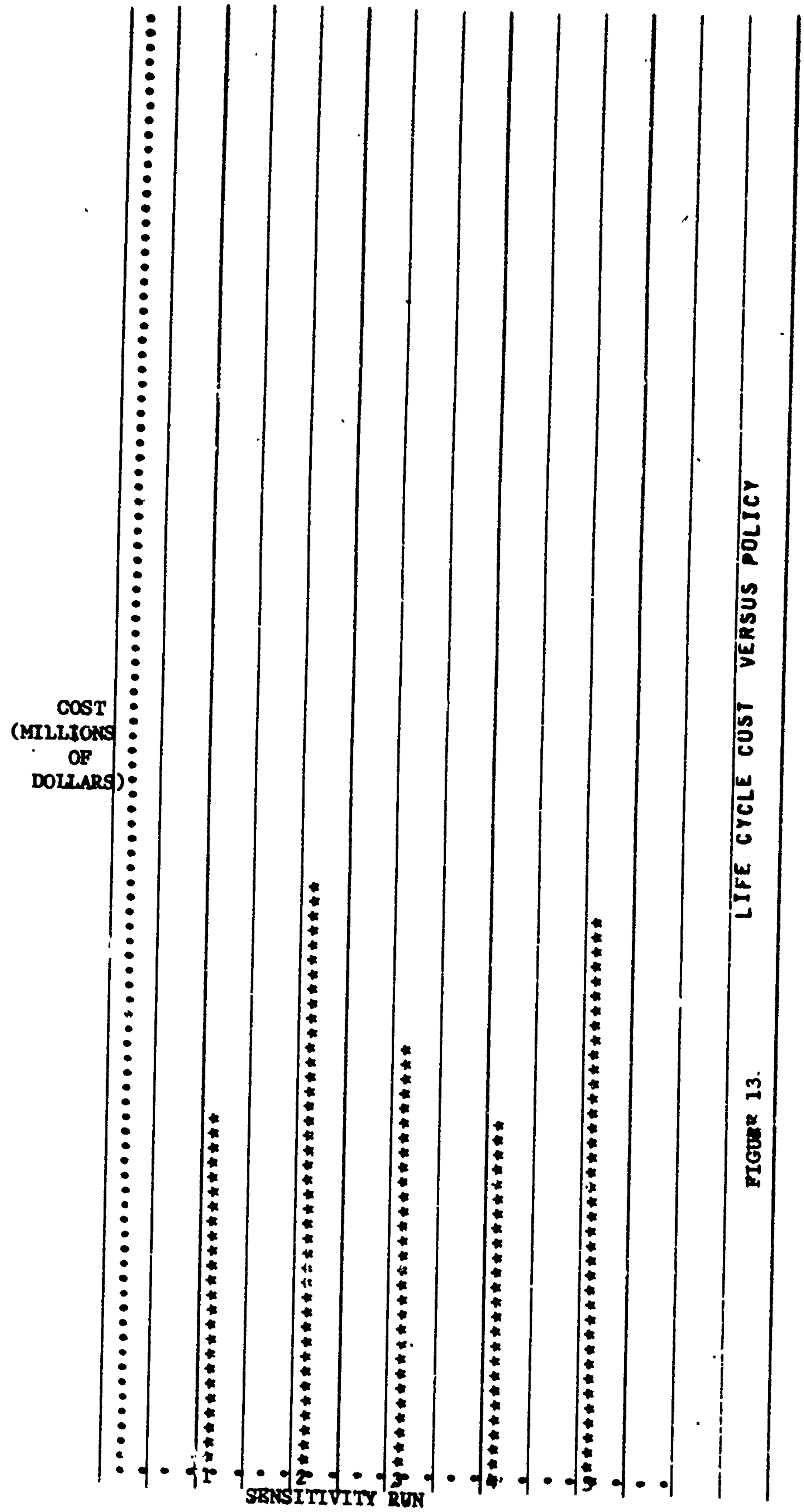


FIGURE 13. LIFE CYCLE COST VERSUS POLICY

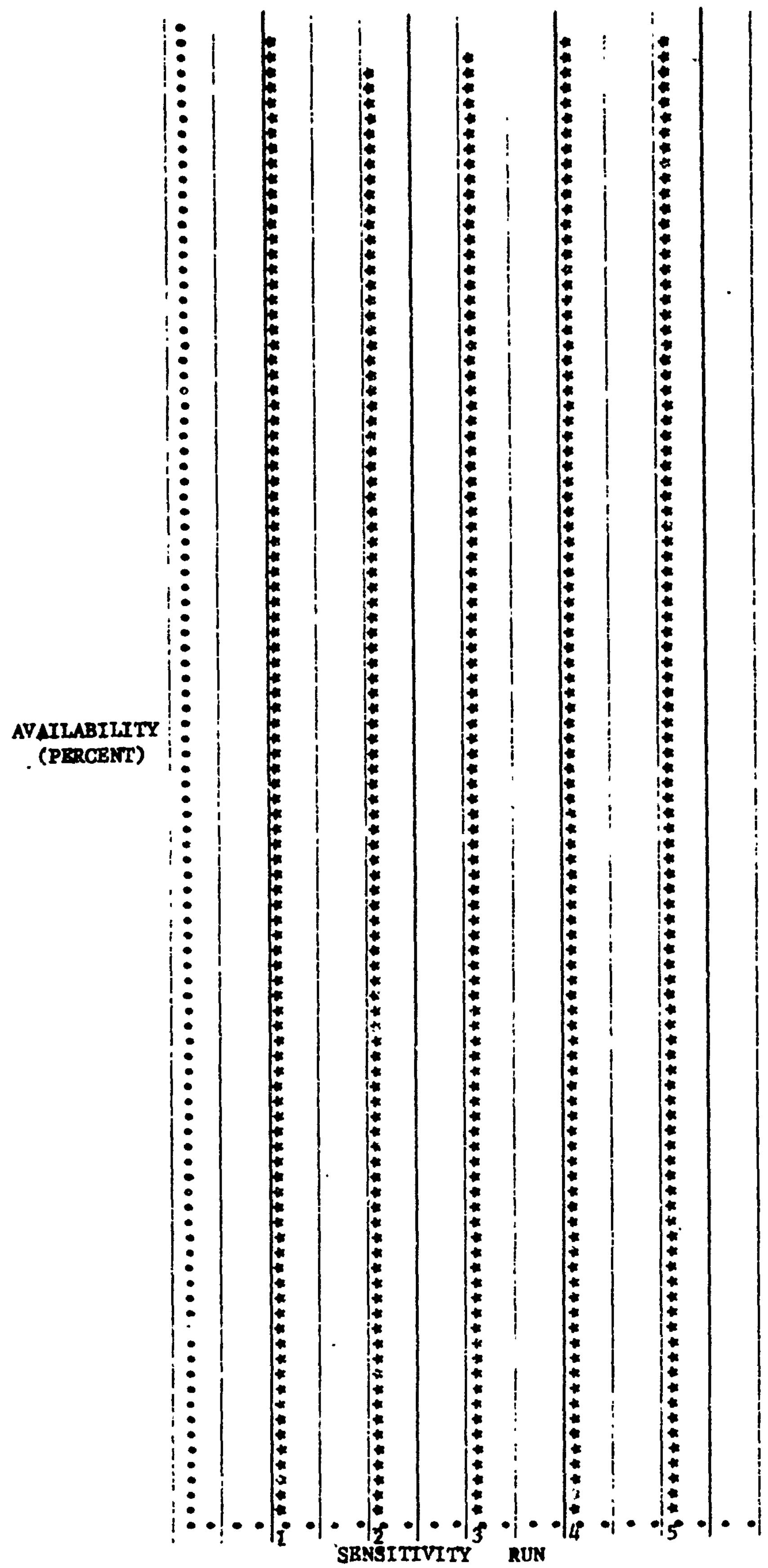


FIGURE 14 AVAILABILITY VERSUS POLICY

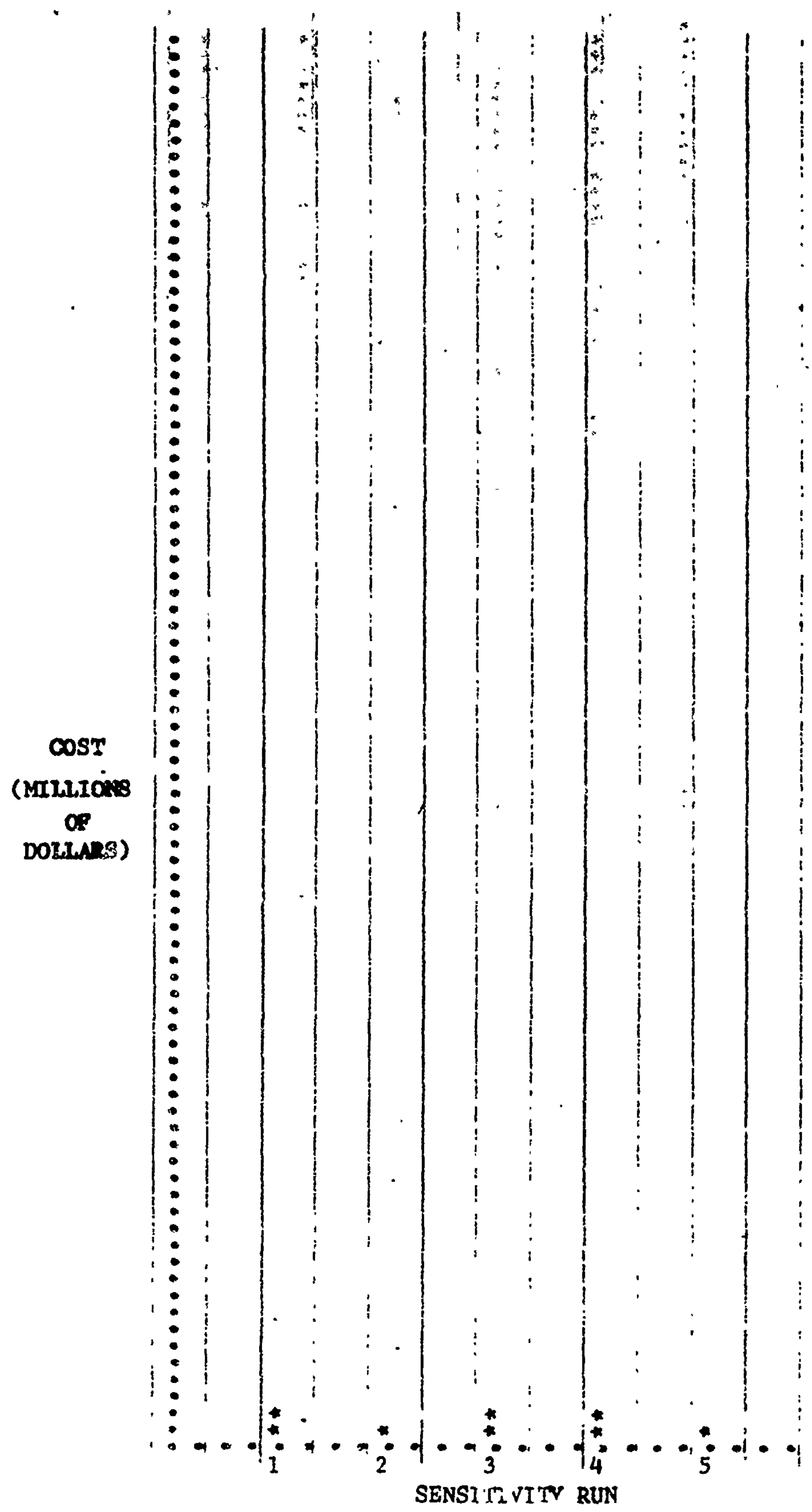


FIGURE 15 COST EFFECTIVENESS VERSUS POLICY

CHAPTER IX

CONCLUSION

The GEMM development program has been completed. The GEMM Model is now operating on the Burroughs 5500 and IBM 360/65 computers. The equations in GEMM have been reviewed for accuracy and the logic flow of the program has been tested for errors. A sample problem was constructed of fictitious data to test the logic flow and computer subroutines. Manual calculation were performed on a small desk-top computer and compared to the GEMM outputs. The results of the comparison proved the accuracy of the logic flow and computer subroutines.

GEMM exhibits a degree of versatility not commonly found in support models. It is capable of optimization in an automatic mode and it can also be used to analyze a variety of maintenance situations in a manual mode. In the automatic mode, a specified number of maintenance policies can be evaluated and maintenance requirements will be output for the optimum policy. If it is necessary to review the maintenance requirements of each policy independently, then the manual mode can be used to obtain output for each policy.

Sensitivity analysis is another very important attribute of GEMM that yields a high degree of versatility and flexibility. GEMM is capable of sensitivity analysis on numerous different inputs variables. This is an invaluable tool for identifying variables that have a large impact on life cycle support costs and operational availability.

A common fault with many support models is the severe structuring of the model that allows little or no activity at the man-model interface. This type of model is completely automatic and the user merely inputs the data and interprets the results. This restricts the user from becoming involved with the analysis and denies him the privilege of applying his first-hand knowledge to the problem. GEMM provides the user with a powerful tool to which he can apply his first-hand knowledge for a more detailed and beneficial analysis. The automatic mode of GEMM can be used to determine the optimum policy and sensitivity analysis can be performed at the investigators discretion. GEMM enlarges the man-model interface to permit more personalized analysis of design and logistics problems. Decisions on design and logistics of modern, sophisticated systems are much too complicated to be made by one man or group of men without a detailed analysis of many correlated factors. GEMM enables this detailed analysis at a tremendous savings in terms of time and money. This model is, however, only one step in the design of an automatic decision-making process that must be evolved in order to provide timely and cost-effective decisions in this rapidly moving age of technology.

APPENDIX A. GEMM Input Requirements

1. Number of components in equipment
2. Number of classes of parts in equipment
3. Number of modules in each component
4. Number of each part class in each module
5. Reliability information based on equipment operating hours:
   a. Mean-Time-Between Failure for each part class
   b. Mean-Time-Between Failure for each module
   c. Mean-Time-Between Failure for each component
   d. Mean-Time-Between Failure of the equipment
6. Mean-Time to check-out the equipment
7. Mean-Time-To-Repair Information based on active repair time (Fault Diagnosis + Replacement Time + Retest and Re-Calibrate Time):
   a. Mean-Time-To-Repair the equipment
   b. Mean-Time-To-Repair each component
   c. Mean-Time-To-Repair each module
8. Cost of the equipment
9. Cost of the components
10. Cost of the modules
11. Average cost of each part class
12. Number of different types of test equipment required to perform all maintenance functions.
13. Test equipment required to check-out equipment.
14. Test equipment required to fault isolate to the component.
15. Test equipment required to fault isolate to the module.
16. Test equipment required to fault isolate to the part.

17. Cost for each type of test equipment.

18. Number of different types of manpower classifications (MOS).

19. MOS required for check-out-equipment.

20. MOS required for fault isolation to component.

21. MOS required for fault isolation to module.

22. MOS required for fault isolation to part.

23. Cost for each type of MOS (Per Year)

24. Weight of the equipment

25. Weight of each component

26. Weight of each module

27. Number of equipment serviced per shop at each maintenance level

28. Number of maintenance shops of each maintenance level in the force structure

29. Distance in miles between each maintenance level (Between Org and DS, DS and GS, GS andDepot, also Org and GS, Org and Depot, DS and Depot).

30. Cost per pound per mile for transportation (Between the different shops)

31. Requisition time for a part from the depot if part out of stock at level (L) where L can be DS, GS, and the Depot.

32. Requisition time for throwaway module from Depot if module out of stock at level (L) where L can be Org, DS and GS and Depot.

33. Requisition time for throwawey component from Depot if component out of stock at level (L) where L can be Orgn, DS, GS, and Depot.

34. Requisition time for spare equipment from the Depot.

35. Number of days per year that maintenance shops at each level operate.

36. Number of days per year of operation of the equipment.

37. Operating hours per day of the equipment.

38. Confidence limits for stockage of parts, modules, components, and the equipment.

39. Probability of false-no-go.

40. Attrition factor.

41. Requirements objective period.

42. Stockage objective periods between levels.

43. Order and shipping times between levels.

44. Turnaround times for modules between levels.

45. Turnaround times for components between levels.

46. Economic Life.

47. Cost to train each MOS type.

48. Turnover time for manpower.

49. Percentage factor of total stockage cost for Inventory Management.

50. Fraction mean-time-to-repair reduced if maintenance is accomplished at the depot level.

51. Total cost of research & development.

52. Publication information.

* Parts must be classified into different classes. Could be classified according to failure rate, cost, etc.. This classification should probably be done by the R&D engineer.

APPENDIX B. FORTRAN Names and Descriptions

This appendix is divided into three major sections: Input Variables, Program Variables and Subroutines. For each variable the FORTRAN name is given along with a brief description of that variable. This listing may be used along with the flow diagrams in Appendix C to follow the logic of the GEMM Program given in Appendix D.

INPUT VARIABLES

SYMBOL	DESCRIPTION
NC	Number of components
NCLASP	Number of classes of parts
NMK (I)	Number of modules in a component
NUMBR (I,J,KS)	Number of part type (KS) in module (IJ)
MTBFP (K)	Mean-time-between failure for part class (K)
MTBFM (I,J)	Mean-time-between failure for module (I,J)
MTBFC (I)	Mean-time-between-failure for component (I)
MTBFE	Mean-time-between-failure of the equipment
MTTRCE	Mean-time to check-out the equipment
MTTRE	Mean-time-to-repair the equipment
MTTRC (I)	Mean-time-to-repair the component (I)
MTTRM (I,J)	Mean-time-to-repair the module (I,J)
CSEI	Cost of the equipment
CCC (I)	Cost of the Component (I)
CC (I,J)	Cost of module (I,J)
C (K)	Cost of part type (K)
NTE	Number of different types of test equipment required.
TECE (K) 2 or 0 for all K	Test equipment use identifier for check-out equipment
TEEI (K) 1 or 0 for all K	Test equipment use identifier for fault isolate to component
TEC1 (I,K) 1 or 0 for all K	Test Equipment use identifier for fault isolate to module
TEMI (I,J,K) 2 or 0 for all K	Test Equipment use identifier for fault isolate to part

SYMBOL	DESCRIPTION
TECOST (K)	Test Equipment Cost for type (K)
NMOS	Number of different types of manpower classifications
MOSCE (KM) 1 or 0 for all KM	Manpower use identifier for check out equipment
MOSE (KM) 1 or 0 for all KM	M npower use identifier for fault isolation to component
MOSC (I, KM) 1 or 0 for all KM	Manpower use identifier for fault isolation to module
MOSM (I,J,KM) 1 or 0 for all KM	M npower use identifier for fault isolation to part
MCOST (KM)	Manpower cost for type (KM)
WTE	Weight of the equipment
WTC (I)	Weight of component (I)
WTM (I,J)	Weight of module (I,J)
NSHOP (L)	Number of equipment serviced at maintenance level (L)
NUMFS (L)	Number of maintenance shops type (L) in the force structure
TRANST (L, NL)	Distance in miles between maintenance level (L) and (NL)
COSLB (L, NL)	Cost per pound per mile for transportion from level (L) to (NL)
REQPT (L,4)	Requisition time for a part from level (4) if part out of stock at level (L)
REQMT (L,4)	Requisition time for throwaway module from level (4) if module out of stock at level (L)
REQCT (L,4)	Requisition time for throwaway component from level (4) if component out of stock at level (L)
REQET	Requisition time for spare equipment
WAIT (L)	Waiting time for maintenance at level (L)
OPHRSH (L)	Operating hours per day of maintenance shop at level (L

SYMBOL	DESCRIPTION
NDAY	Number of days per year of operation of maintenance shops
NDAE	Number of days per year of operation of the equipment
OPHRDY	Operating hours per day of the equipment
K1,K2,K3,K4	Confidence limits for stockage of parts, modules, components, and the equipment
PFNGO	Probability of false-no-go
ATRF	Attrition factor
ROP	Requirements objective period
B(L)	Stockage objective periods between levels
G(L)	Order and shipping times between levels
TURN1(L)	Turnaround times for modules between levels
TURN2(L)	Turnaround times for components between levels
ELIFE	Economic life
XMAN (KM)	Cost to train manpower type (KM)
TRAIN	Turnover time for manpower
FACTIN	Percentage factor of total stockage cost for Inventory Management
TRANS (L, NL)	Distance in time between maintenance level (L) and (NL).
PROD	Productive factor of manpower.
CTOE	Cost to overhaul equipment.
CTOC (I)	Cost to overhaul component type (I).
CTOM (I, J)	Cost to overhaul module type (I, J).
TBOE	Time between overhauls of equipment.
TBOC (I)	Time between overhauls of component type (I).

TBOM (I, J)	Time between overhauls of module type (I, J)
REQ	Requisition time of an equipment float.

PROGRAM VARIABLES

AMMHC(I) - AMMH for repair of component.

AMMHCE - Annual Maintenance Manhours (AMMH) for check-out equipment.

AMMHM (I, J) - Annual Maintenance Manhours for a module.

AMMHM (I, J) - AMMH for repair of module.

AMMHE - AMMH for repair of equipment.

AVAILA - Operational Availability

COE (I) - Level for Checkout of Equipment.

CSTK (L, K) - Cost of part stock for printout.

CSTLC (L, I) - Cost of Component Stock for Printout.

CSTKM (NL, I, J) - Cost of Module Stock for Printout.

CSTRNC (I)-Cost of Transportation for Components.

CSTRNE - Cost of Transportation for Equipment.

CTINVI - Adds up inventory costs for printout.

CTRM - Adds up training cost for printout

FIC (I) - Level for Fault Isolation to Component.

FICT - Tradeoff value for FIC level.

FIM (I) - Level for fault isolation to module.

FIMS (I) - Cost for Optimum level for FIM.

FIMT (I) - Tradeoff value for FIM level.

FIP (I) - Level for fault isolation to part.

FIPS (I, J) - Cost for optimum FIP level.

FIPT (I, T) - Tradeoff cost for FIP level.

GAVAL (I) - Values for availability for different sensitivity runs.

GCOST (I) - Values for cost for different sensitivity runs.

GCSTE (I) - Value for cost-effectiveness for different sensitivity runs.

I - Component Indicator

II - X Value in graph routine represents input policy run.

IR - Sets poli / equal to next policy.

J - Module Indicator

K - Part type indicator

L - Maintenance level where FIP accomplished.

LEMIN - Optimum repair level for the equipment.

LMMIN (I) - Optimum repair level for components.

LMS (I) - Optimum level for FIM.

LPMIN (I, J) - Optimum repair level for modules.

LPP (I, J) - Optimum FIP level for given FIM level.

LPS (I, J) - Optimum FIP level.

LX - Indicates next policy to be evaluated.

M - Specifies policy to be investigated.

MMLEV (L, KM) - Adds up manpower requirements for printout.

MMNUM (KM) - Force structure requirement for printout.

MOSCC - Total manpower cost for FIC for a given policy.

MOSCM (I) - Total test equipment cost for FIM of a component.

MOSCP (I, J) - Total cost for manpower for a module.

MOSEC - Manpower cost for COE

MPT - Mean down time for equipment

NL - Maintenance level where FIM accomplished.

NNL - Maintenance level where FIC accomplished.

NNLEV (L, KK) - Adds up test equipment requirements for printout.

NOFAIC (I) - Number of components which fail during a year.

NOFAIE - Number of equipment which fail during a year

NOFAIL (I, J) - Number of module which fail during a year.

REST - Total reorder stock cost for printout.

ROPART - Adds up reorder stock cost for printout.

ST1 (K) - Initial provisioning replacement part stock.

ST3 (K) - Initial provisioning initial issue parts stock.

STCM (I) - Cost of the stock of modules for a component.

STCP (I, J) - Cost of initial provisioning part cost for a module.

STKC (NNL, I) - Requirements for component stockage.

STKCR (I) - Requirements for reorder component stock.

STKE - Number of end item stock required manpower.

STKEC - Cost of end item stock for printout.

STKM (NL, I, J) - Initial provisioning stock for modules.

STKMR (I, J) - Reorder stock for modules.

STKTC (NNL, I) - Number of throwaway components required for initial provisioning.

STKTC (NNL, I) - Requirements for throwaway components.

STKTCR (I) - Number of throwaway components required for reorder.

STKTCR (I) - Requirements for reorder stock for throwaway components.

STKTM (NL, I, J) - Number of throwaway modules required for initial provisioning.

STKTM (I, J) - Requirements for throwaway modules.

STKTMR (I, J) - Number of throwaway modules required for reorder.

STKTMR (I, J) - Requirements for reorder stock for throwaway modules.

STL (K) - Initial provisioning order-ship part stock

STR (K) - Reorder stock for parts.

SUMC - Total of optimum FIMS's for the equipment.

SUME - Total cost for repair for modules, components, and the end item.

SUMEMN - Optimum total cost for the whole equipment.

SUMM - Total cost for modules of a component and component itself.

SUMP - Total of optimum FIPS's for given component.

SUN - Cost for reorder stock for a module.

SUNN - Cost of reorder stock.

SUNNN - Total cost of reorder stock.

T (I) - Indicator for throwaway components.

T (I, J) - Indicator for throwaway modules.

TECC - Total test equipment cost for a given policy.

TECM (I) - Total manpower cost for FIM of a component.

TECP (I, J) - Total cost of test equipment for a module.

TEEC - Test Equipment Cost for COE.

TINVIN - Inventory Costs.

TOMOS - Total MOS cost for printout.

TOMOSS - Total manpower cost for printout for life.

TOSTK - Total stock cost for initial provisioning for printout.

TOTCSC - Total cost for repair of components

TOTCSM (I) - Total cost of modules for a component.

TOTCSP (I, J, L) - Total cost for repair of a module at a given level of maintenance.

TOTE - Total test equipment cost for printout.

TOTEND - Total cost for check out of equipment including end item stock.

TOTRNS - Total transportation cost for one year.

TOTRSS - Total transportation cost for printout.

TRM - Training Cost

TSTOCK - Total stockage cost for printout.

TTC - Turnaround time of a component.

TTE - Turnaround time of equipment.

TTM - Turnaround time of a module.

TTT - Indicator for throawaway end item

VALUE (II) - Y value in graph routine represents cost, availability or cost effectiveness.

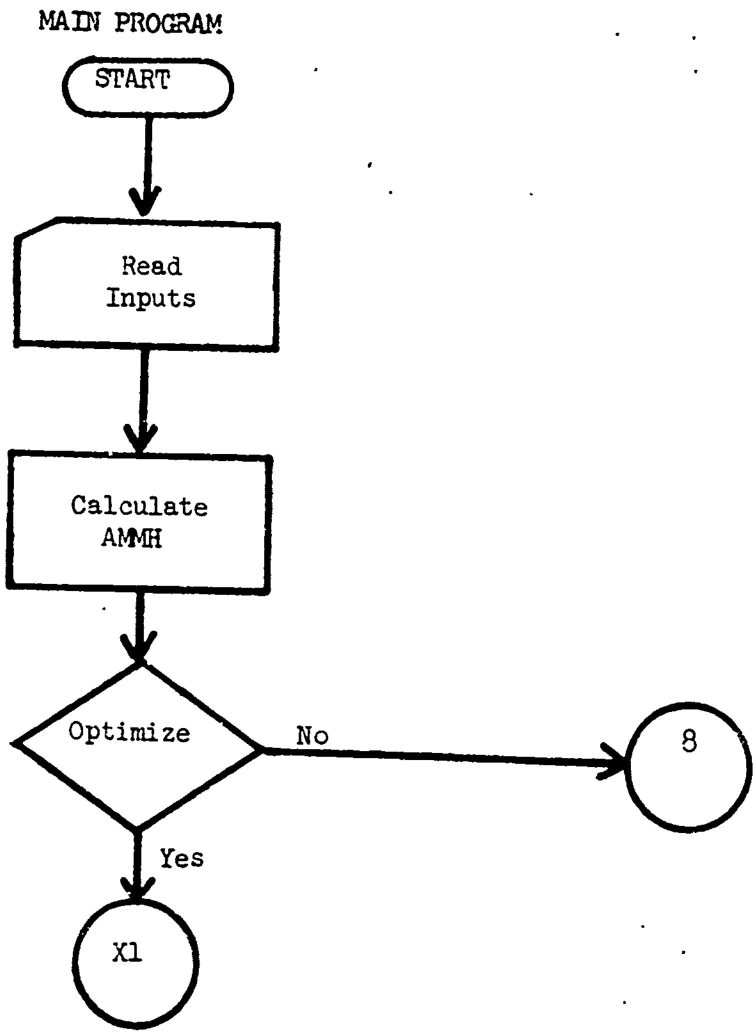
ZZ - Resets policy indicator.

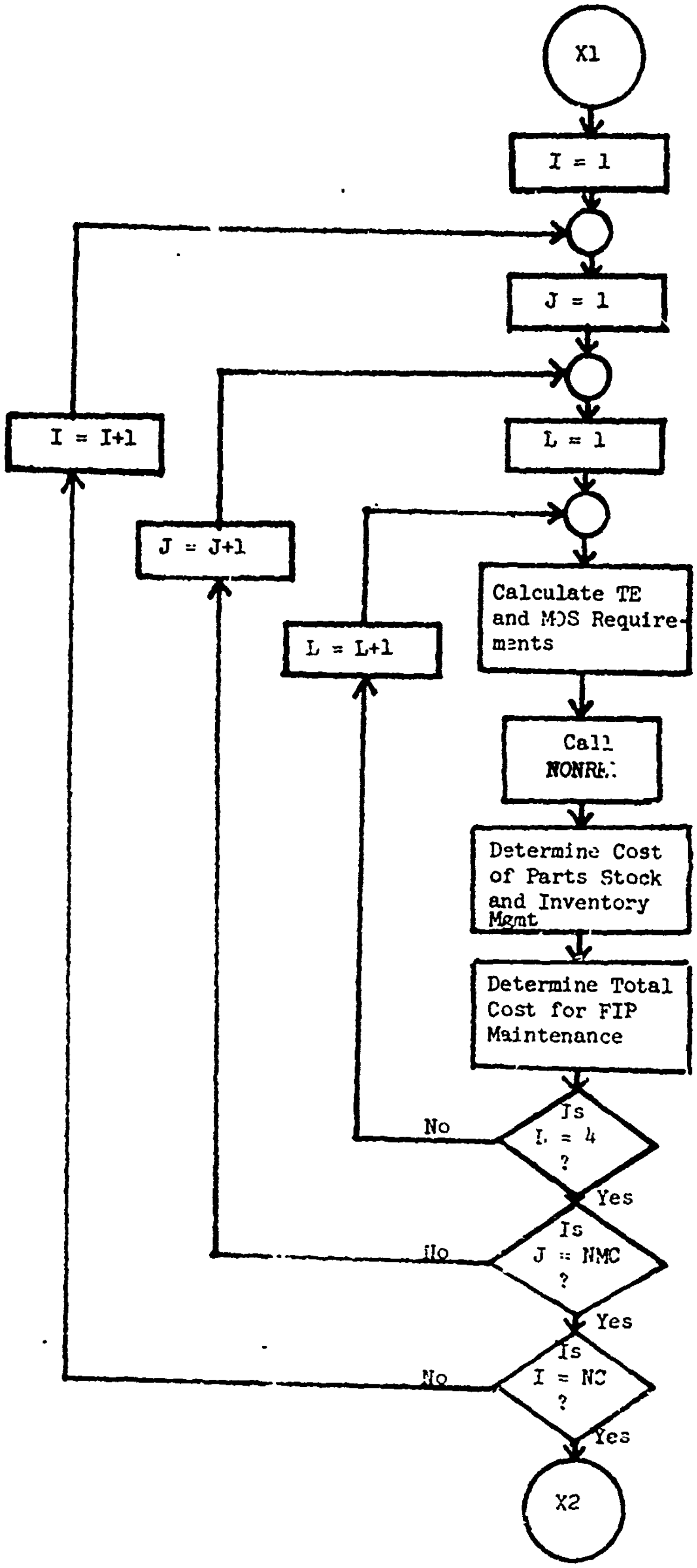
SUBROUTINES

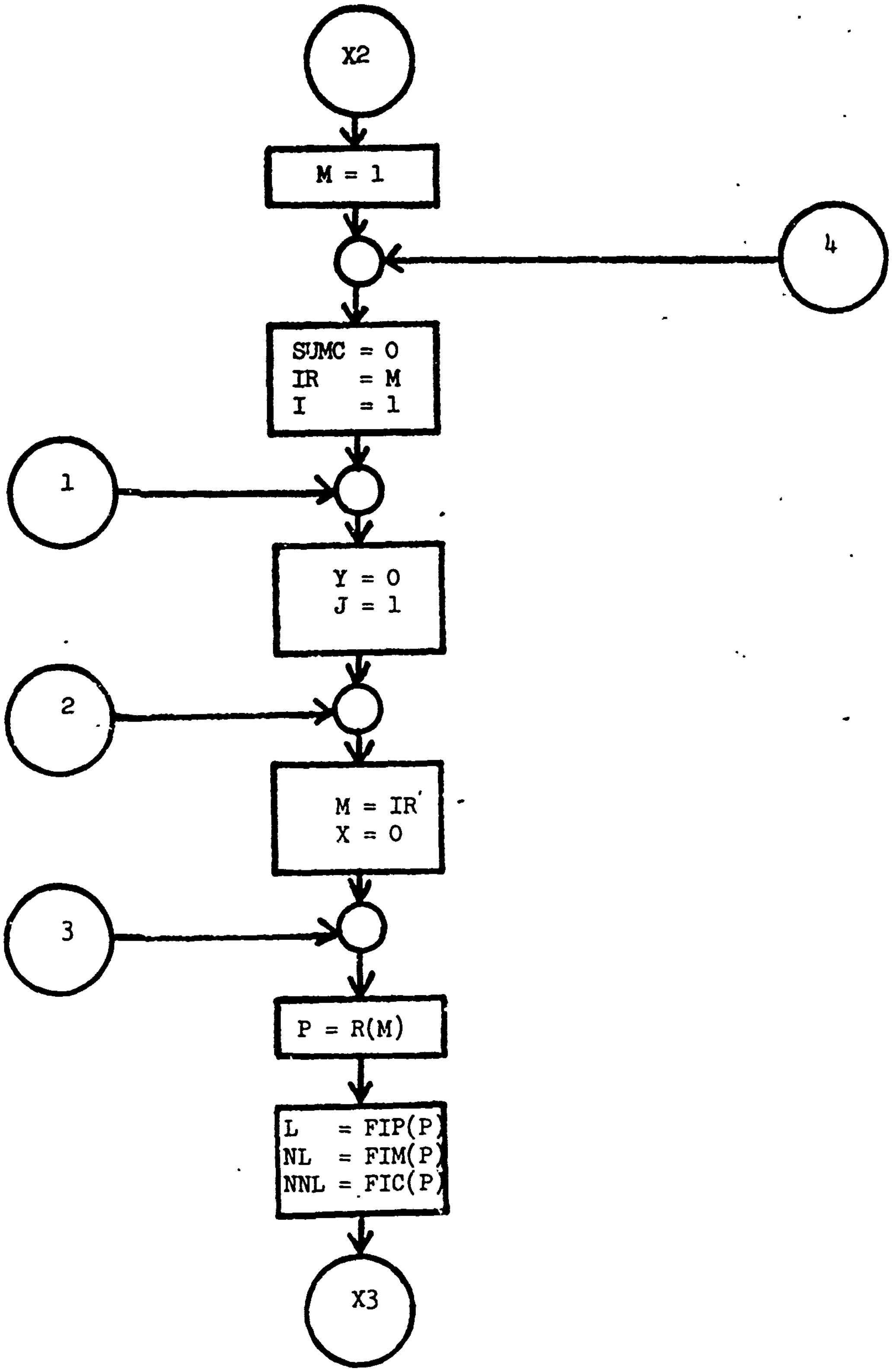
SYMBOL	DESCRIPTION
MTBFMD	Calculates mean time between failure of modules
MTBFCM	Calculates mean time between failure of components
MTBFEQ	Calculates mean time between failure of equipment
ANMH	Calculates Annual Maintenance Manhours (AMMH) for modules, components and the end item.
XFIM	Calculates repair or maintenance requirements for components except for stockage. Those requirements include manpower, test equipment and training.
XFIC	Calculates maintenance requirements for the repair of the end item itself except for stockage. These requirements include manpower, test equipment and training.
XCOE	Calculates maintenance and stockage requirements for the check-out of the end item. Requirements include manpower, test equipment, training and end item float or throwaway end items.
TRANSM	Calculates transportation costs for modules between levels of maintenance
TRANSC	Calculates transportation costs for components between levels of maintenance.
TRANSE	Calculates transportation costs for the end item between levels of maintenance.
THRMOD	Calculates stockage requirements for modules to receive throwaway maintenance.
THRCOM	Calculates stockage requirements for components to receive throwaway maintenance.
NRFPE	Calculates stockage requirements for the end item to receive throwaway maintenance.
NONREP	Calculates stockage requirements for non-repairable parts for all levels.
REPMOD	Calculates stockage requirements for repairable modules.
REPCOM	Calculates stockage requirements for repairable components.
REPEND	Calculates stockage requirements for repairable end items.

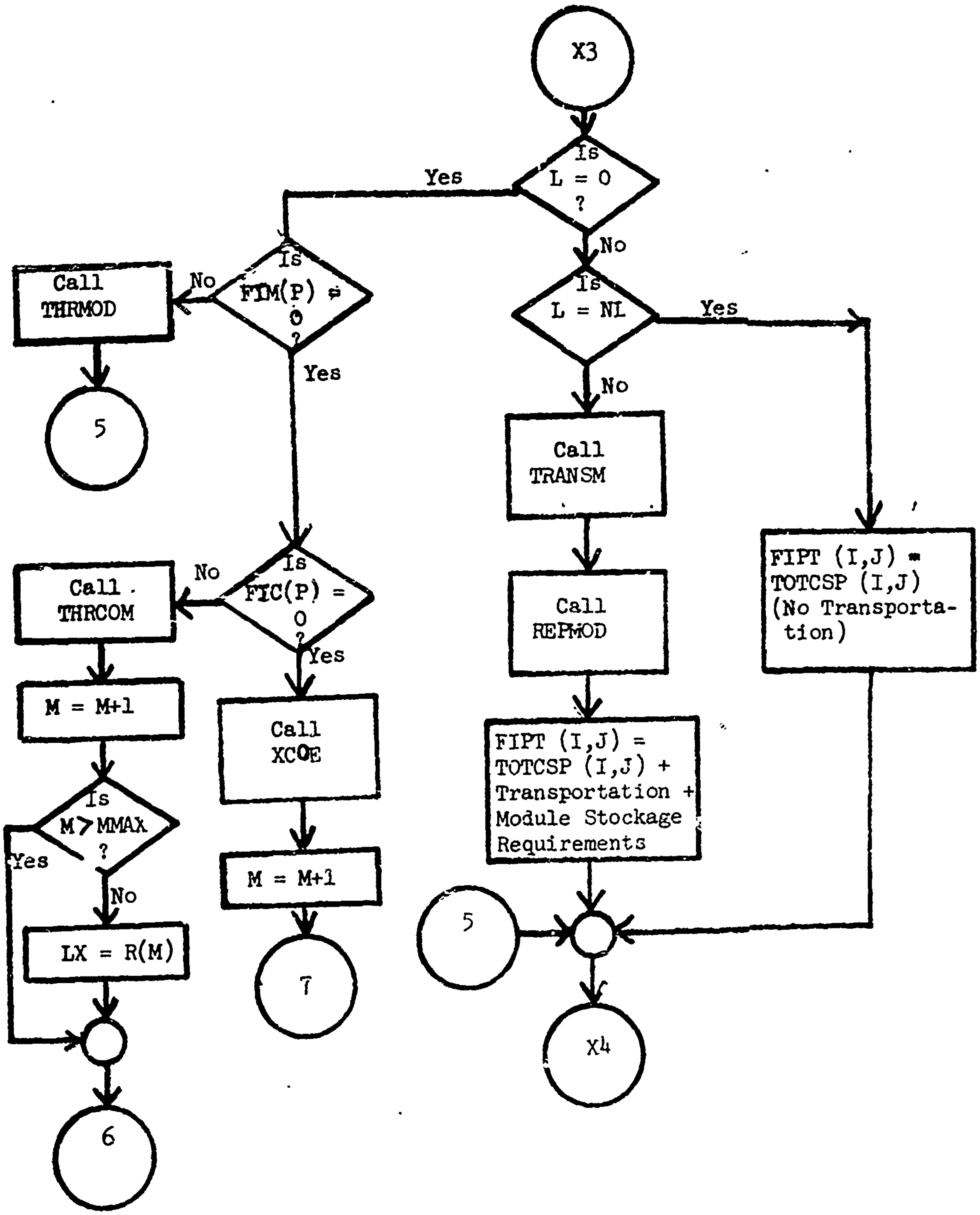
SYMBOL	DESCRIPTION
AVAIL	Calculates operational availability for the equipment under study.
GRAPHA	Output routine for graphical representation of cost, availability and cost-effectiveness.

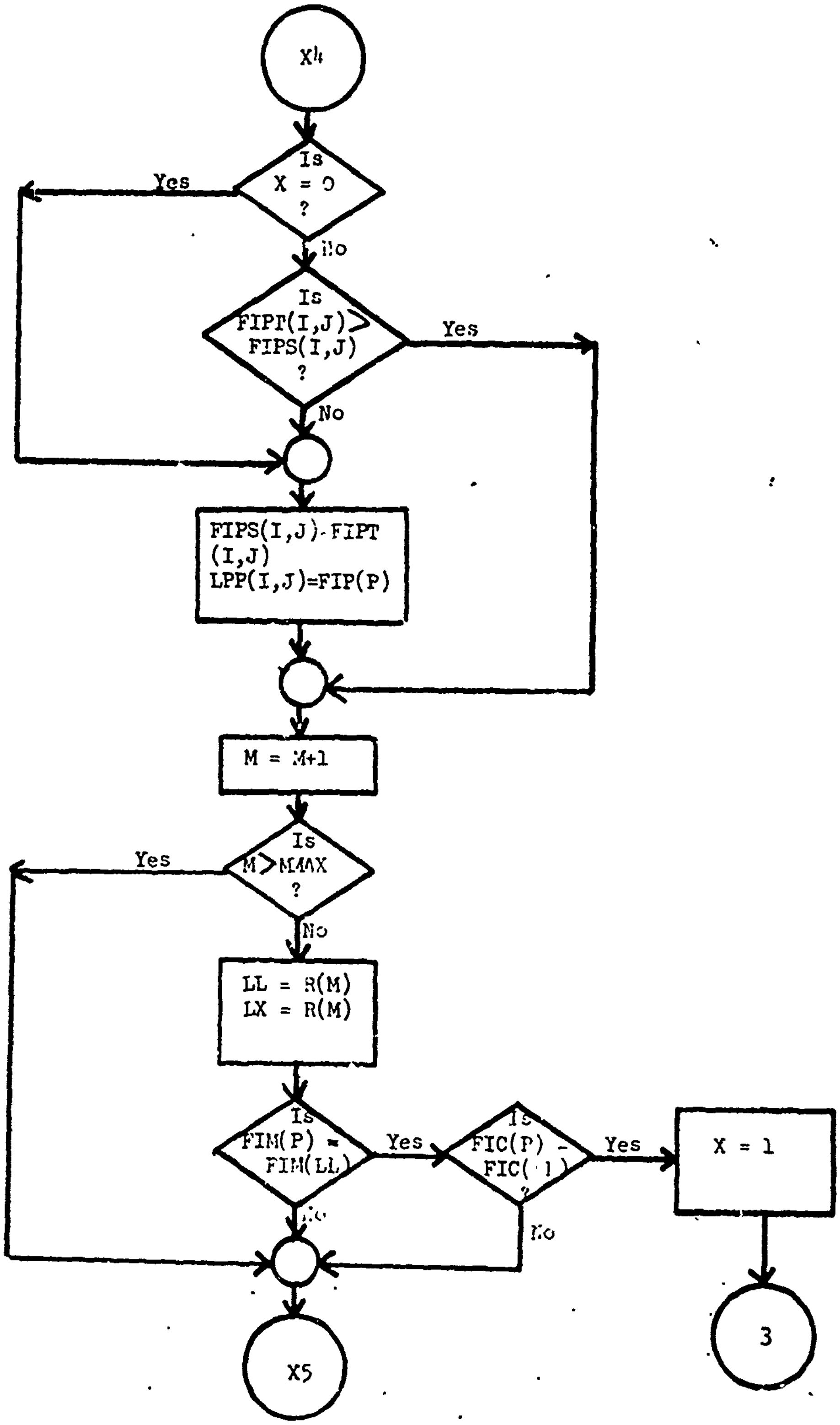
APPENDIX C. FLOW DIAGRAMS

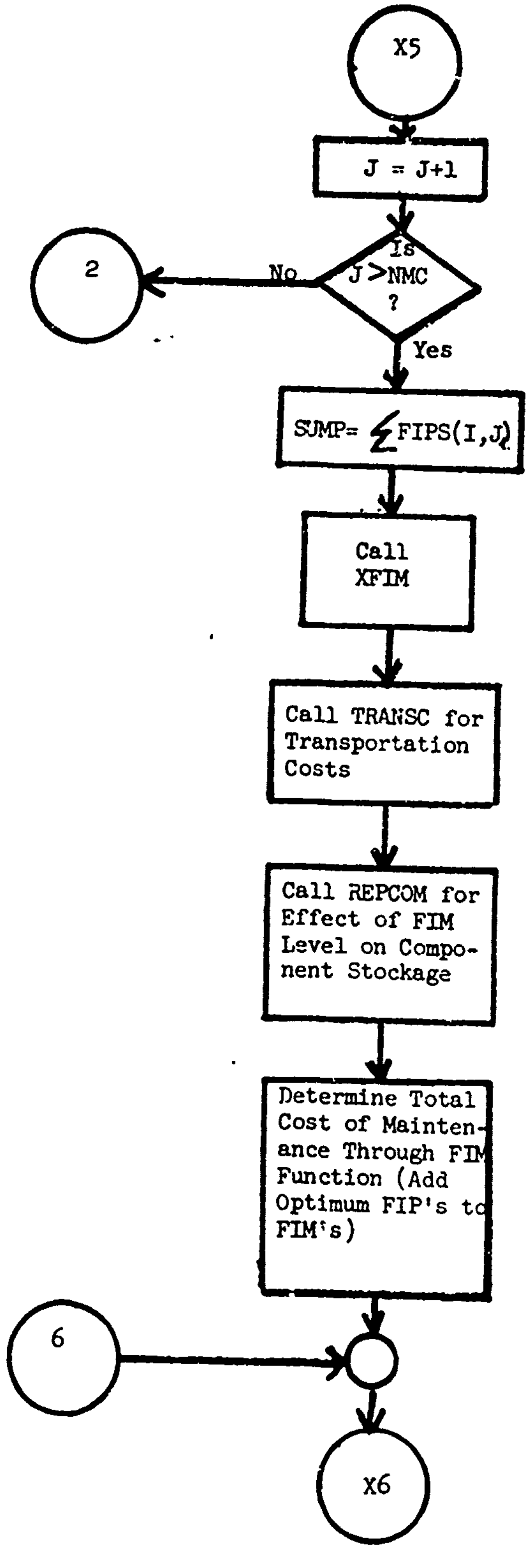


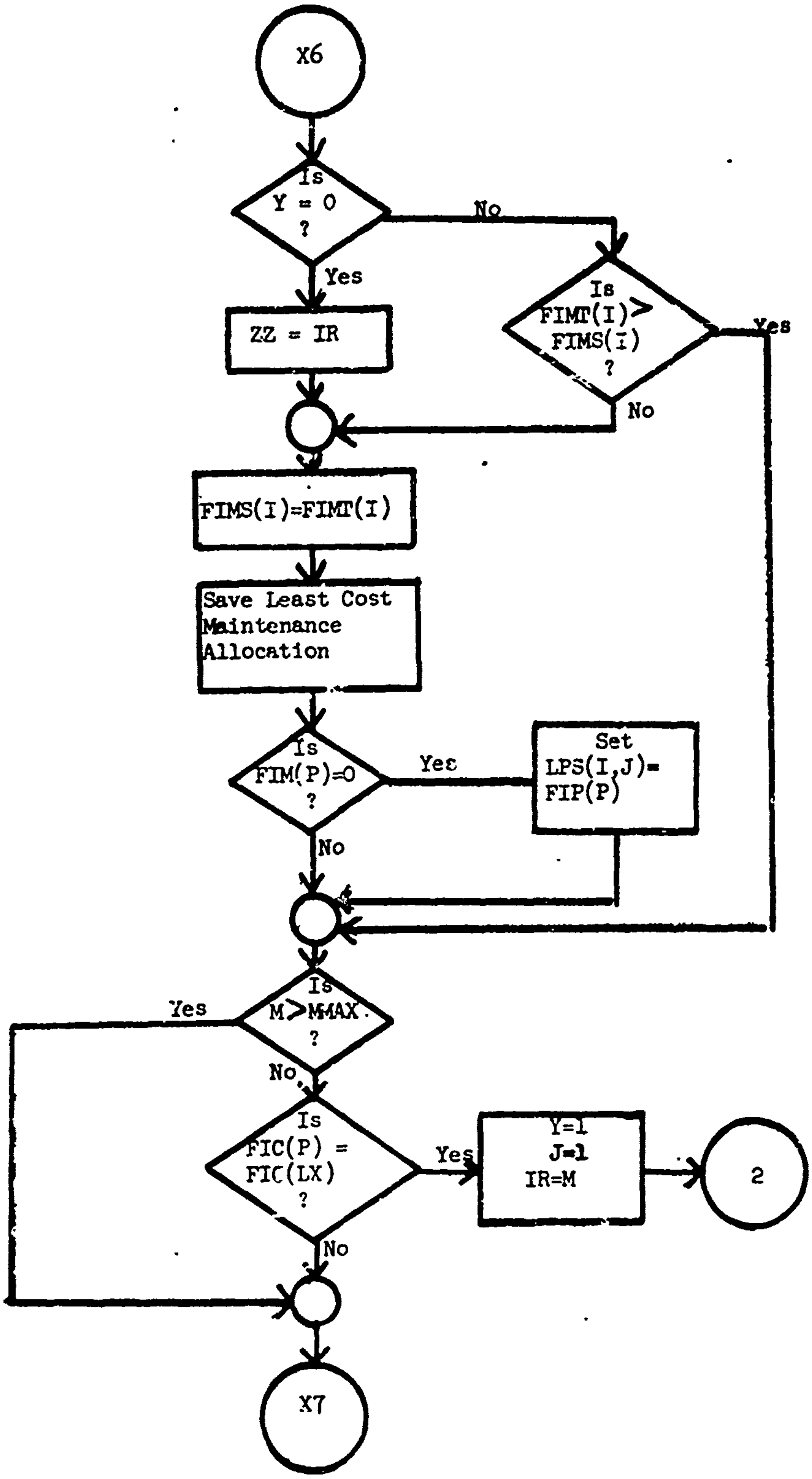

X1
I = 1
J = 1
L = 1
I = I+1
J = J+1
L = L+1
Calculate TE and MOS Requirements
Call NONREC
Determine Cost of Parts Stock and Inventory Mgmt
Determine Total Cost for FIP Maintenance
Is L = 4 ?
No
Yes
Is J = NMC ?
No
Yes
Is I = NC ?
No
Yes
X2

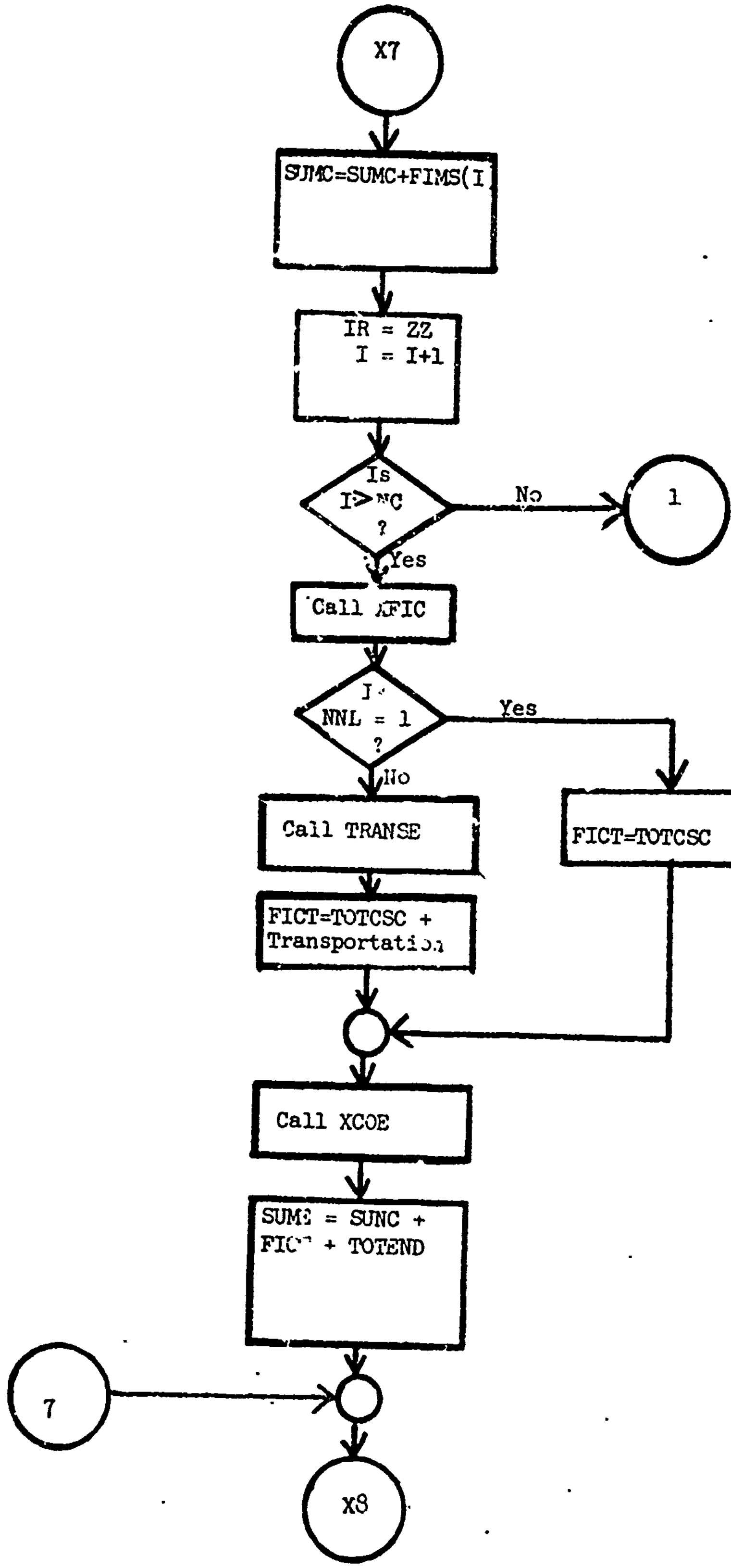

X2
M = 1
4
SUMC = 0
IR = M
I = 1
1
Y = 0
J = 1
2
M = IR
X = 0
3
P = R(M)
L = FIP(P)
NL = FIM(P)
NNL = FIC(P)
X3

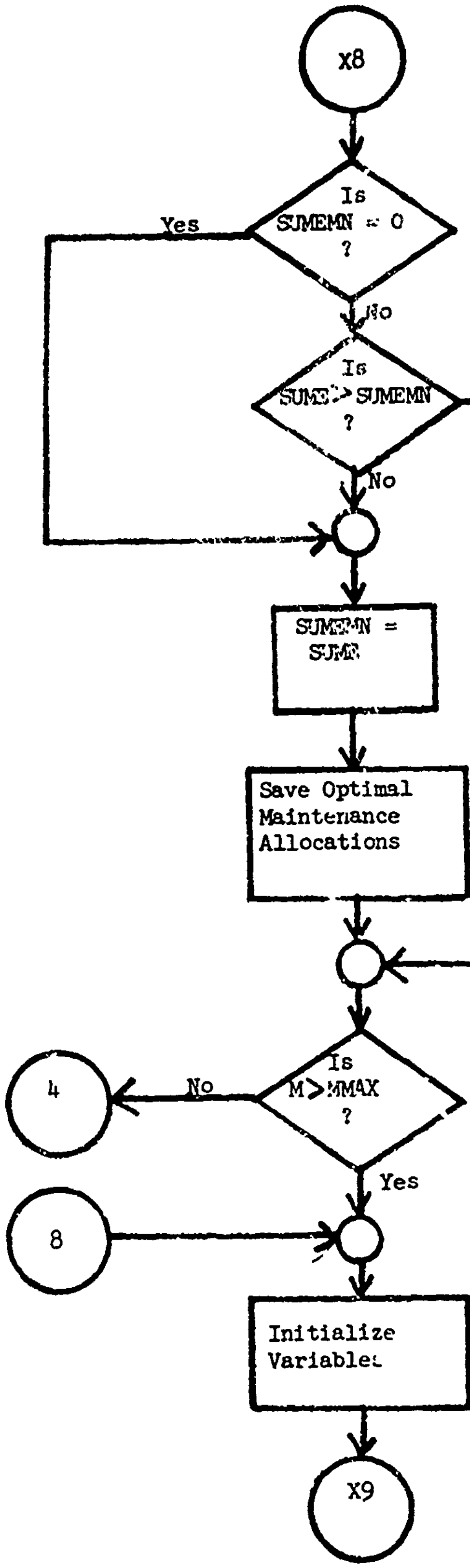

X3
Is
L = 0
?
Yes
No
Is
FIM(P) ≠
0
?
No
Call
THRMOD
5
Yes
Is
L = NL
Yes
No
Call
TRANSM
Call
REPMOD
FIPT (I,J) =
TOTCSP (I,J) +
Transportation +
Module Stockage
Requirements
FIPT (I,J) =
TOTCSP (I,J)
(No Transporta-
tion)
Is
FIC(P) =
0
?
No
Yes
Call
THRCOM
M = M+1
Is
M > MMAX
?
Yes
No
LX = R(M)
6
Call
XCOE
M = M+1
7
5
X4


X4
Is
X = 0
?
Yes
No
Is
FIPT(I,J) >
FIPS(I,J)
?
Yes
No
FIPS(I,J)-FIPT
(I,J)
LPP(I,J)=FIP(P)
M = M+1
Is
M > MMAX
?
Yes
No
LL = R(M)
LX = R(M)
Is
FIM(P) =
FIM(LL)
?
Yes
No
Is
FIC(P) =
FIC(
?
Yes
No
X = 1
3
X5

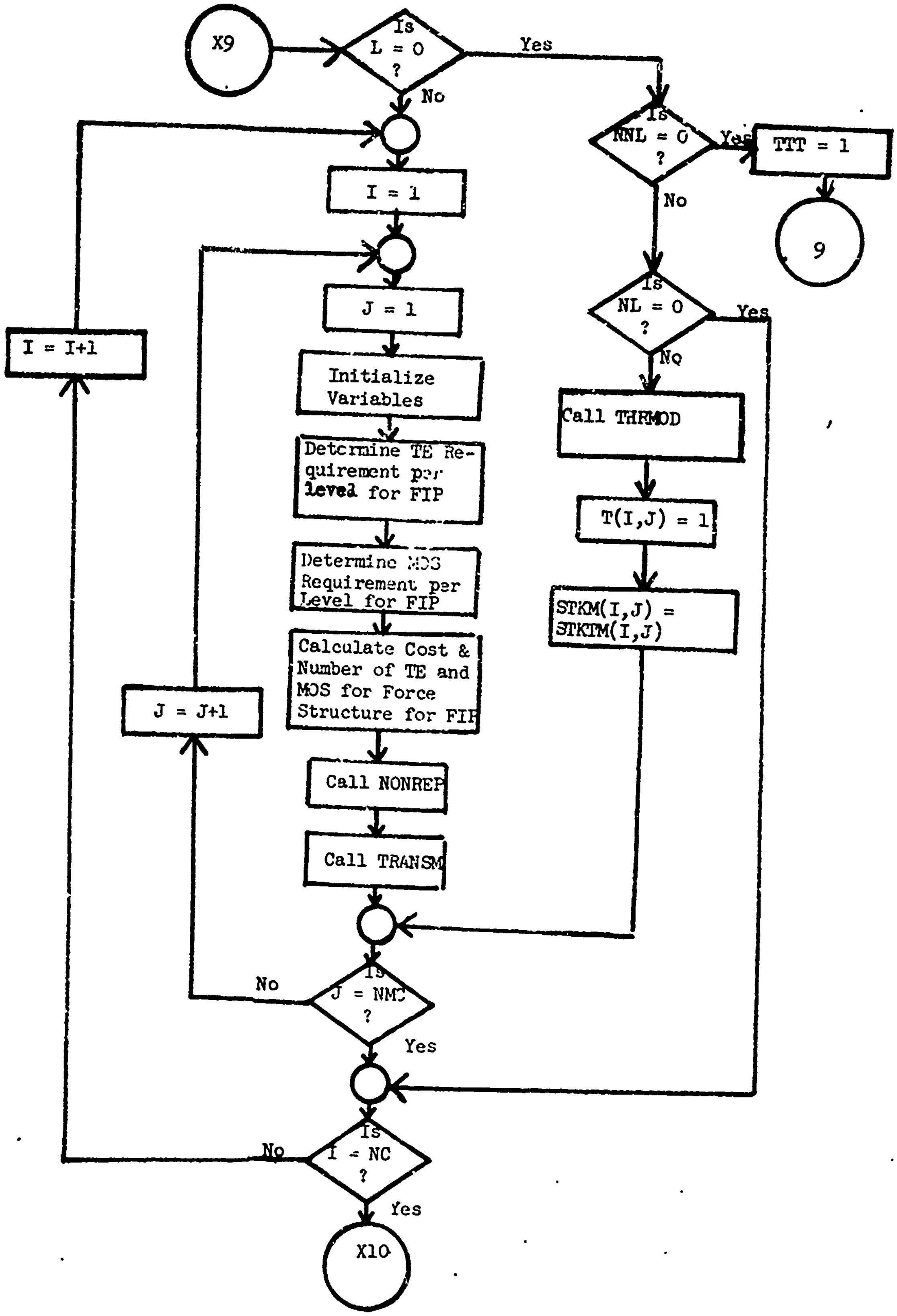

X5
J = J+1
2
No
Is J >NMC ?
Yes
SUMP= ΣFIPS(I,J)
Call XFIM
Call TRANSC for Transportation Costs
Call REPCOM for Effect of FIM Level on Component Stockage
Determine Total Cost of Maintenance Through FIM Function (Add Optimum FIP's to FIM's)
6
X6

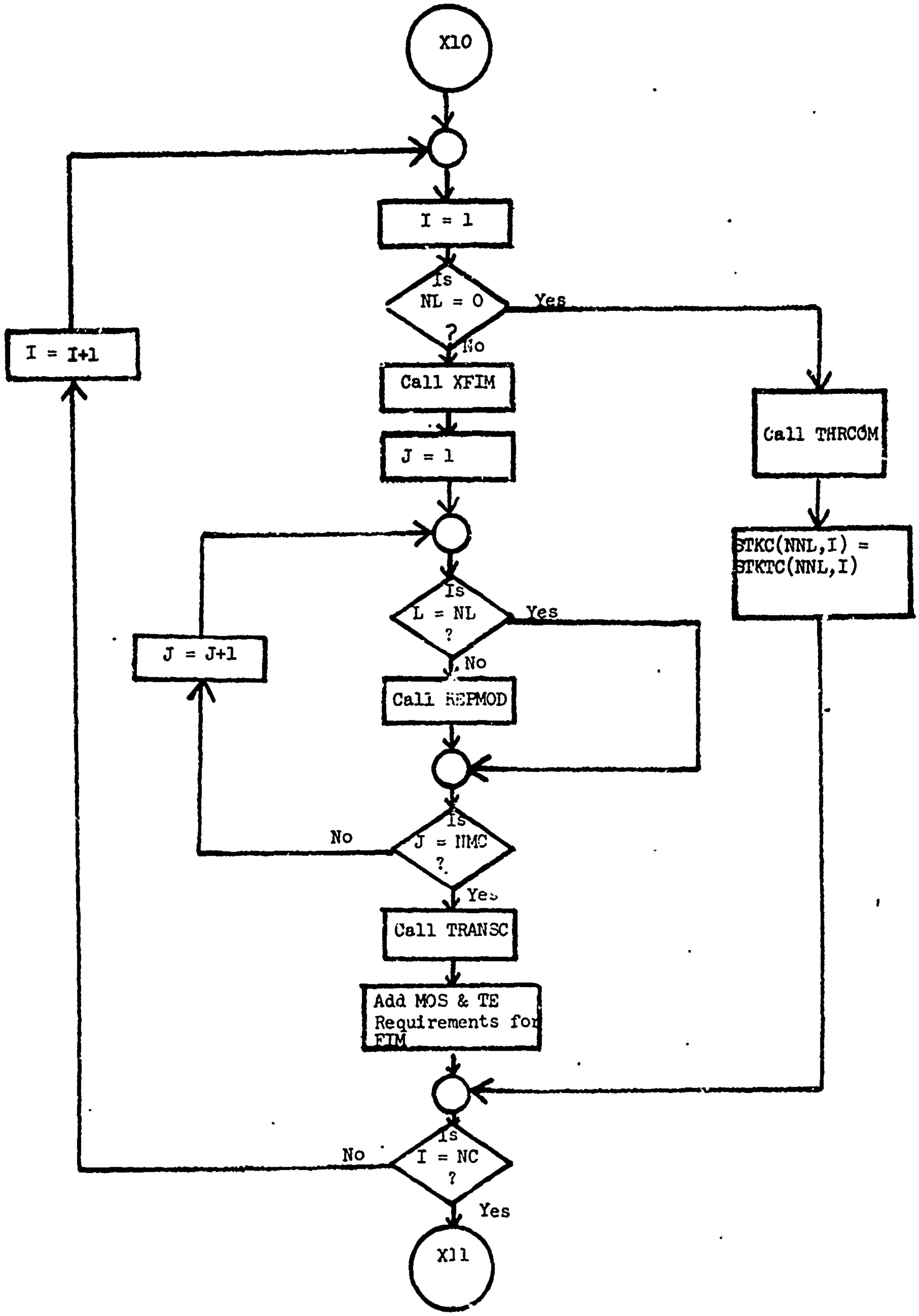

X6
Is
Y = 0
?
No
Yes
ZZ = IR
Is
FIMT(I)>
FIMS(I)
?
Yes
No
FIMS(I)=FIMT(I)
Save Least Cost
Maintenance
Allocation
Is
FIM(P)=0
?
Yes
Set
LPS(I,J)=
FIP(P)
No
Is
M>MMAX
?
Yes
No
Is
FIC(P) =
FIC(LX)
?
Yes
Y=1
J=1
IR=M
2
No
X7

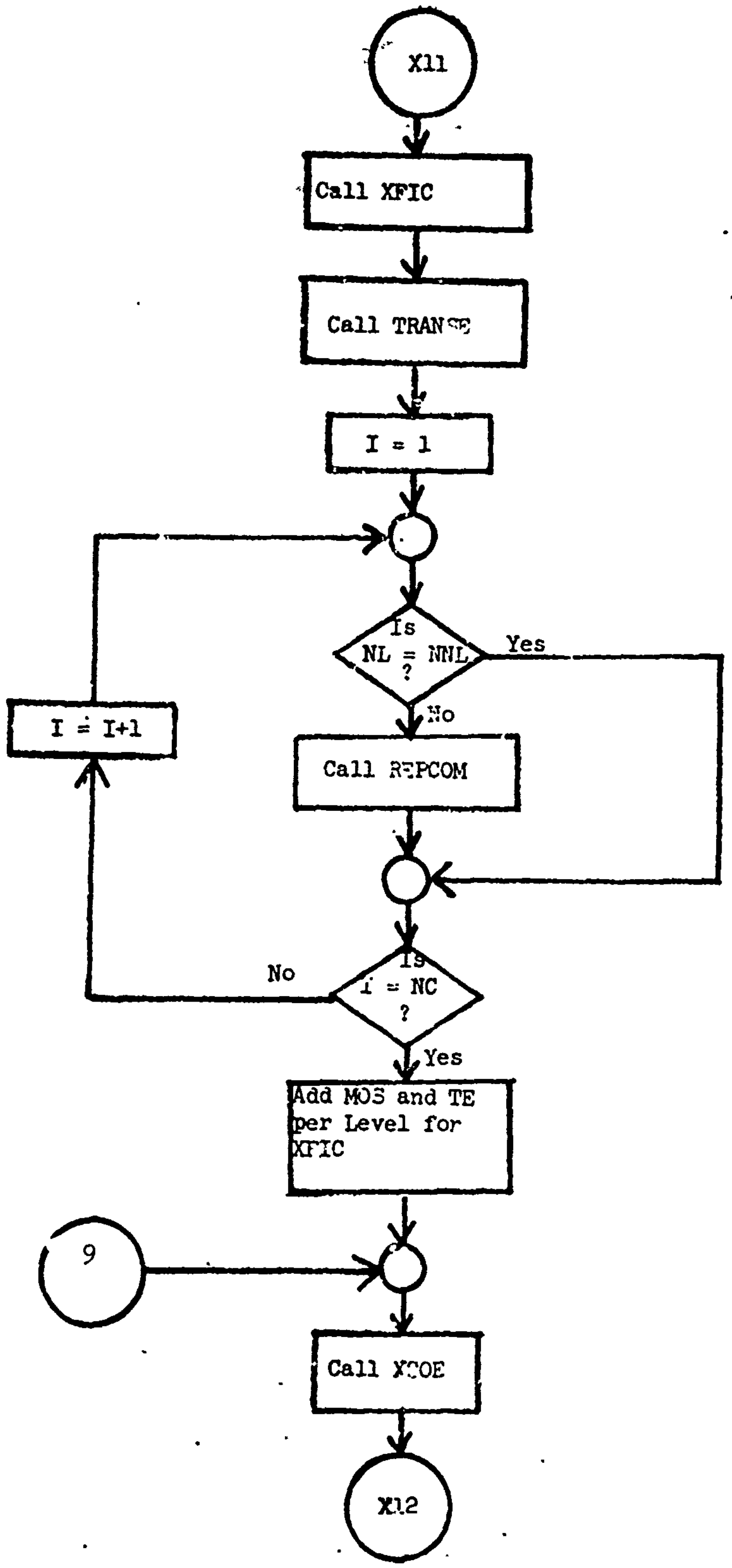

X7
SUMC=SUMC+FIMS(I
IR = ZZ
I = I+1
Is
I> NC
?
No
1
Yes
Call XFIC
Is
NNL = 1
?
Yes
No
Call TRANSE
FICT=TOTCSC
FICT=TOTCSC +
Transportation
Call XCOE
SUMC = SUNC +
FICT + TOTEND
7
X8

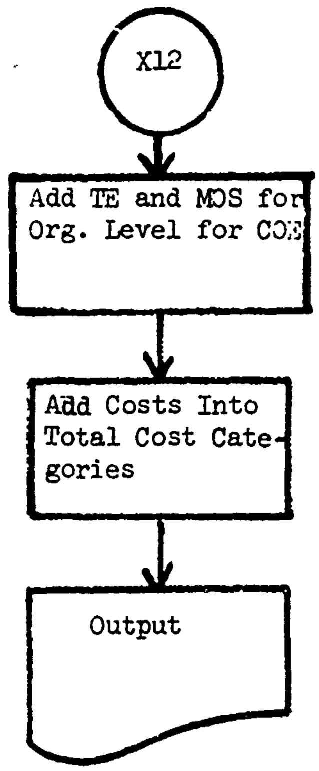


X8
Is SUMEMN = 0 ?
Yes
No
Is SUME > SUMEMN ?
Yes
No
SUMEMN = SUME
Save Optimal Maintenance Allocations
Is M > MMAX ?
No
4
Yes
8
Initialize Variables
X9

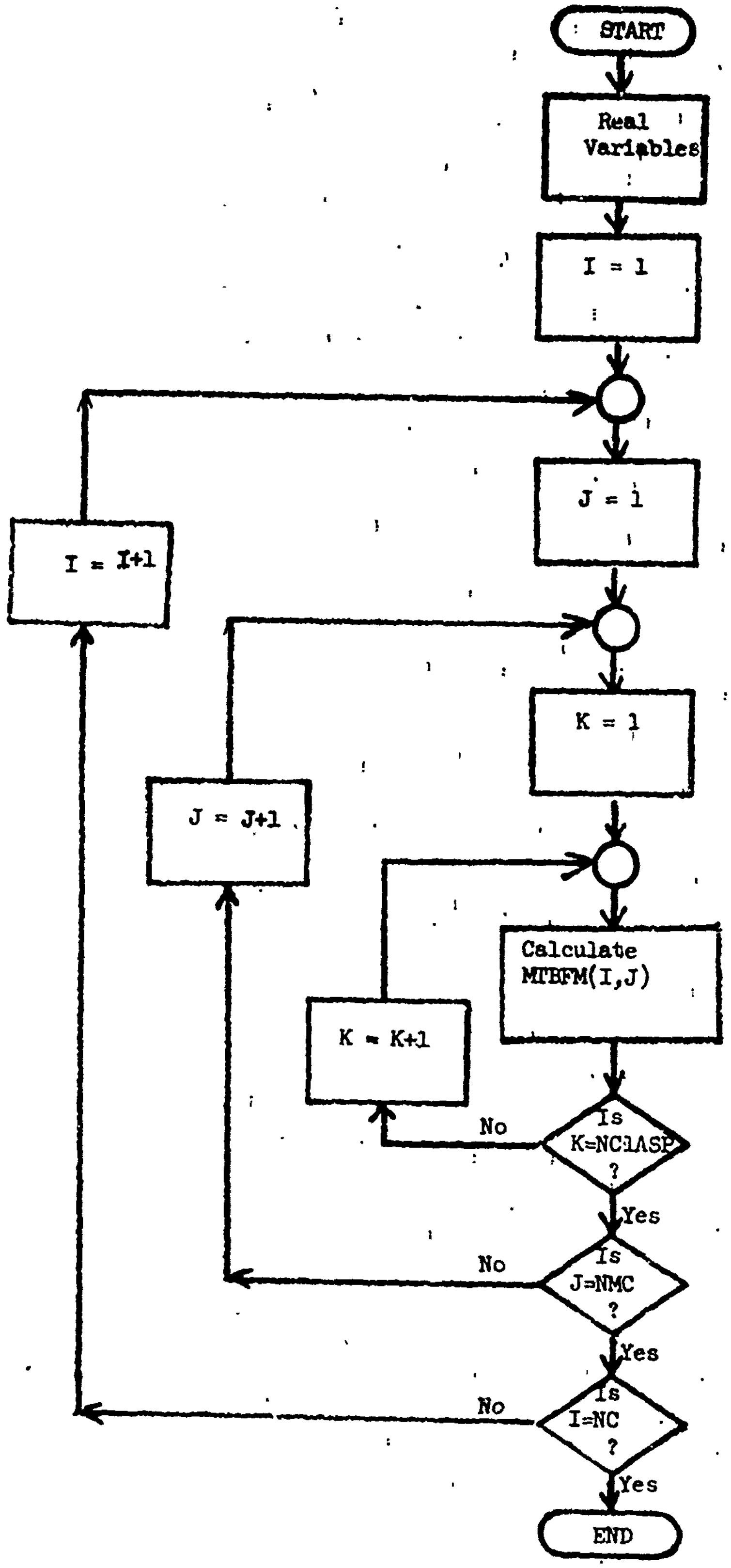

X9
Is L = 0 ?
Yes
No
Is NNL = 0 ?
Yes
TTT = 1
9
No
Is NL = 0 ?
Yes
No
Call THRMOD
T(I,J) = 1
STKM(I,J) = STKTM(I,J)
I = 1
J = 1
I = I+1
Initialize Variables
Determine TE Requirement per level for FIP
Determine MOS Requirement per Level for FIP
Calculate Cost & Number of TE and MOS for Force Structure for FIP
J = J+1
Call NONREP
Call TRANSM
No
Is J = NMC ?
Yes
No
Is I = NC ?
Yes
X10


X10
I = 1
Is NL = 0 ?
Yes
No
Call XFIM
J = 1
Call THRCOM
STKC(NNL,I) = STKTC(NNL,I)
I = I+1
Is L = NL ?
Yes
No
J = J+1
Call REPMOD
Is J = NMC ?
No
Yes
Call TRANSC
Add MOS & TE Requirements for FIM
Is I = NC ?
No
Yes
X11

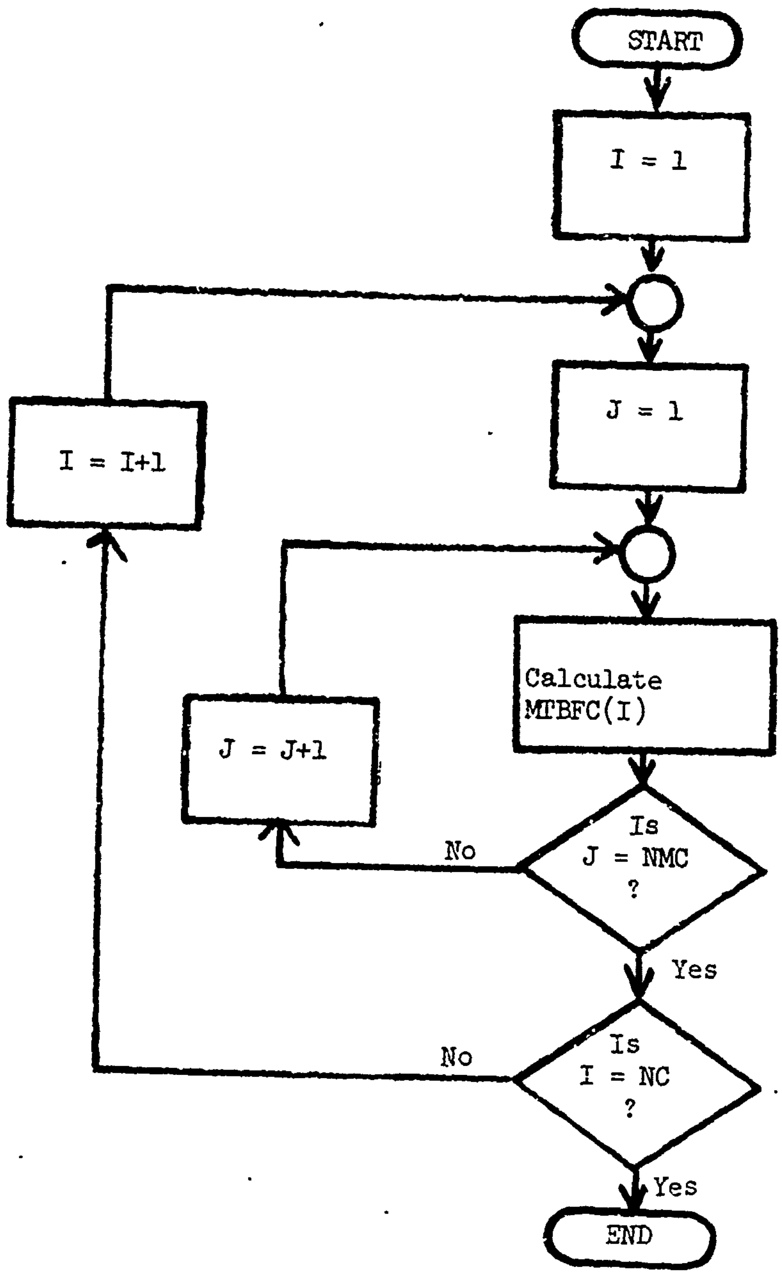

X11
Call XFIC
Call TRANSE
I = 1
Is NL = NNL ?
Yes
No
Call REPCOM
I = I+1
Is I = NC ?
No
Yes
Add MOS and TE per Level for XFIC
9
Call XCOE
X12


X12
Add TE and MOS for Org. Level for COE
Add Costs Into Total Cost Categories
Output

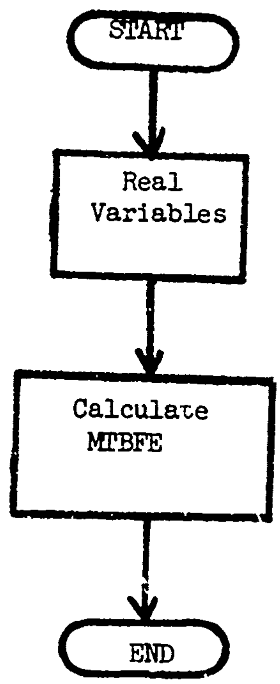
SUBROUTINE MTBFMD



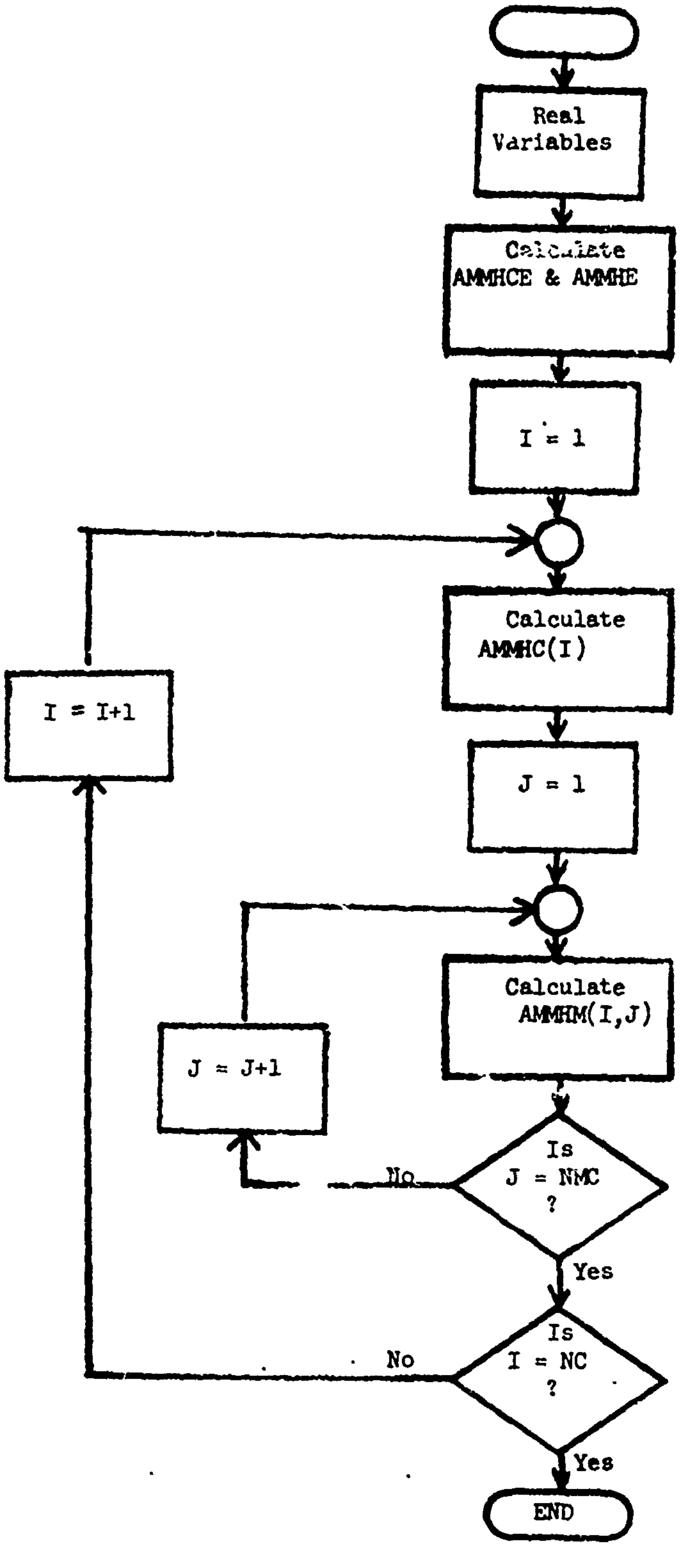
SUBROUTINE MTBFCM



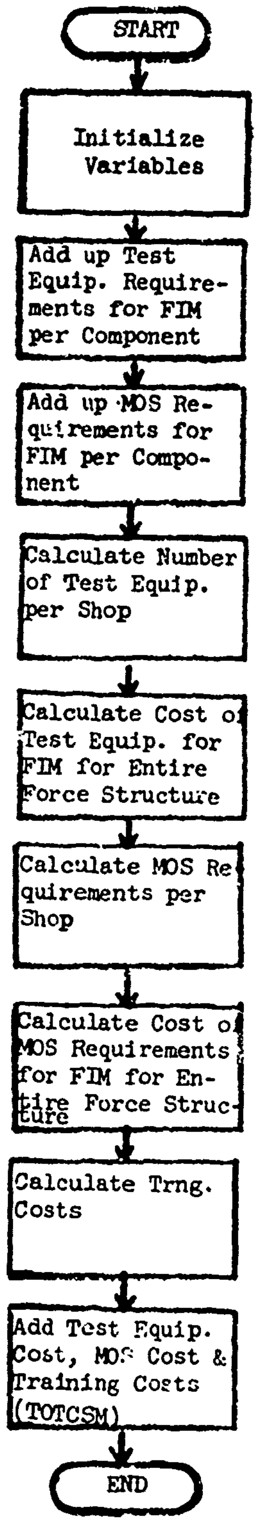
SUBROUTINE MTBFEQ



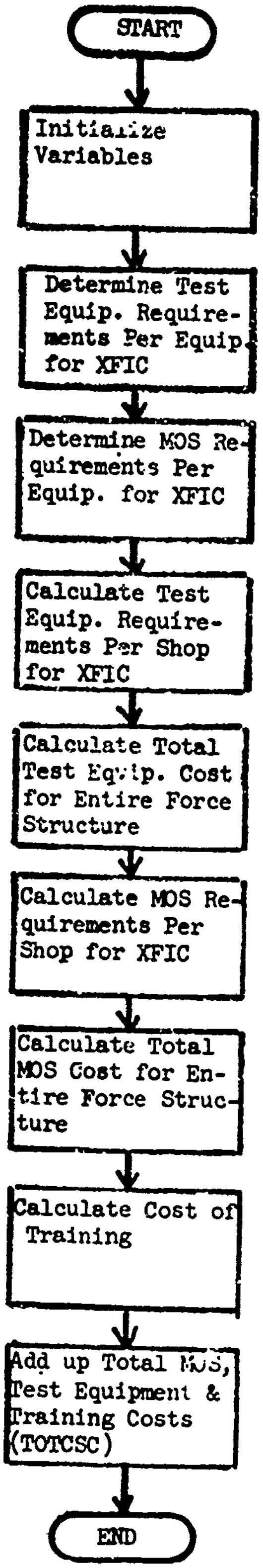
SUBROUTINE AMMH



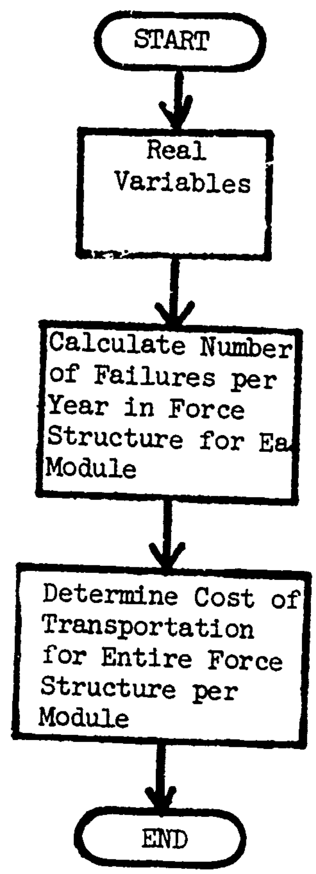
SUBROUTINE XFIM



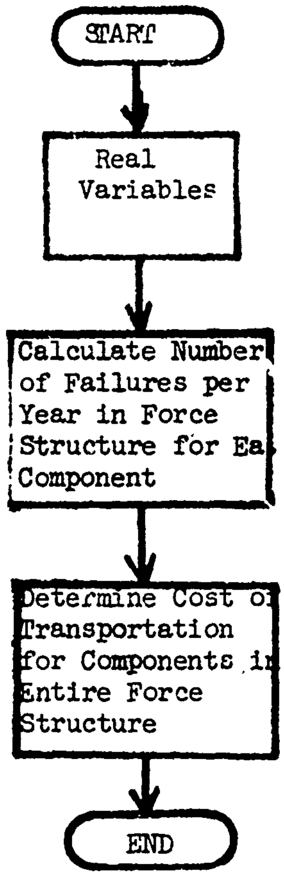
SUBROUTINE XFIC



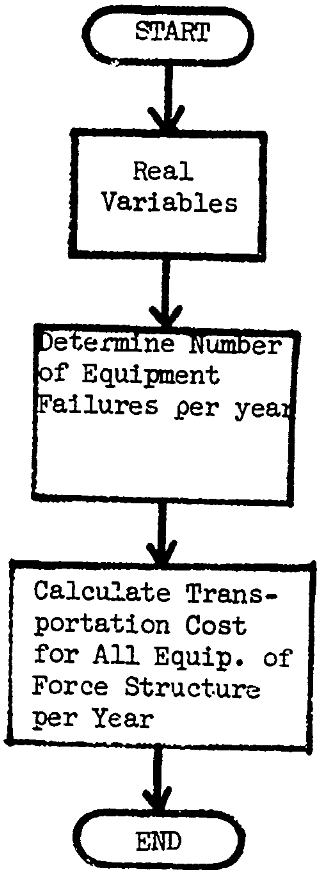
SUBROUTINE TRANSM



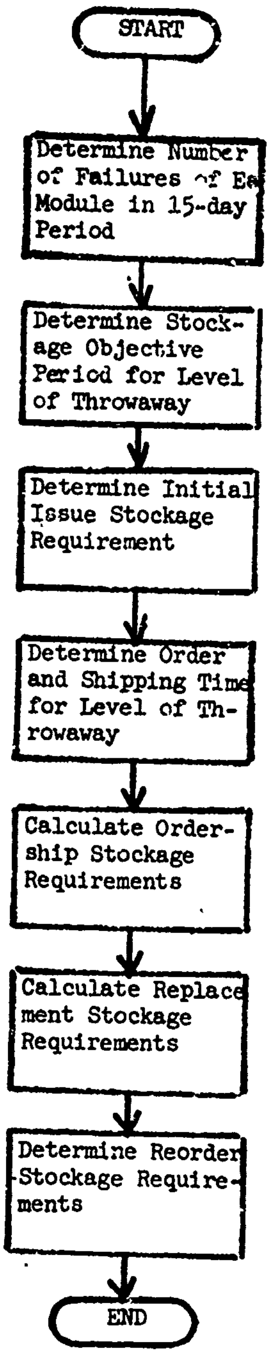
SUBROUTINE TRANSC



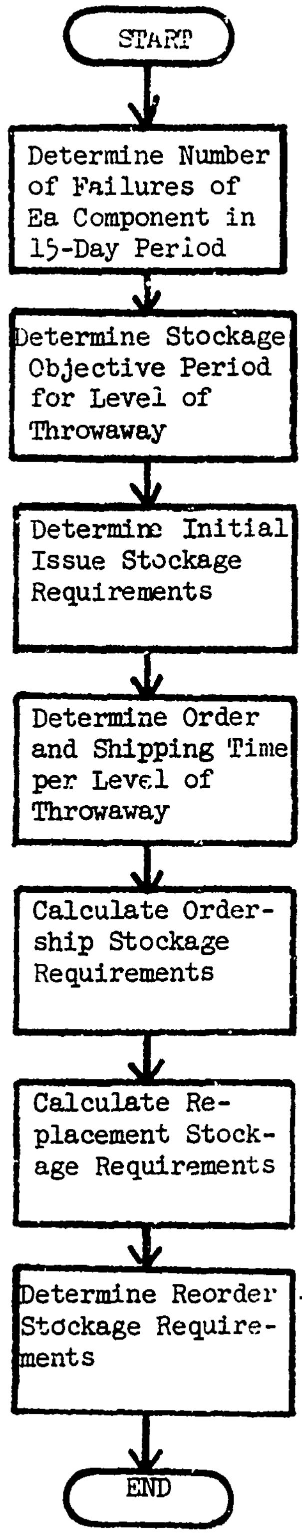
SUBROUTINE TRANSE



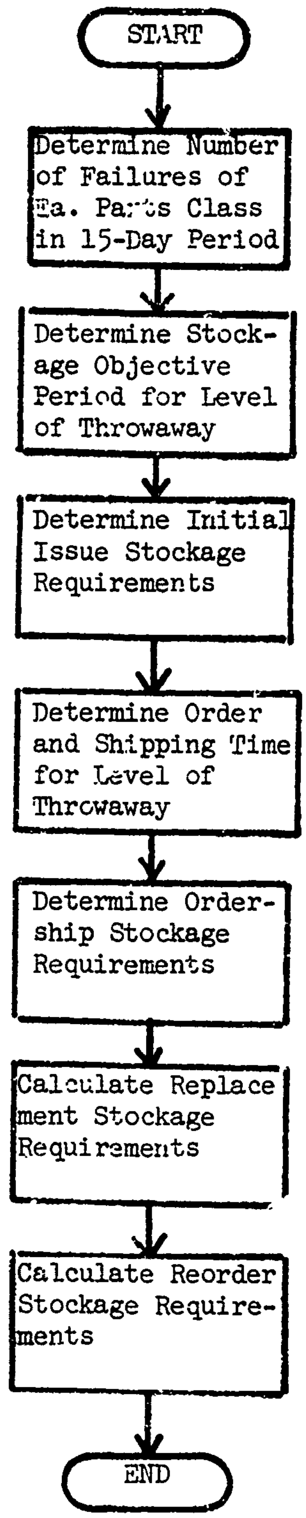
SUBROUTINE THRMOD



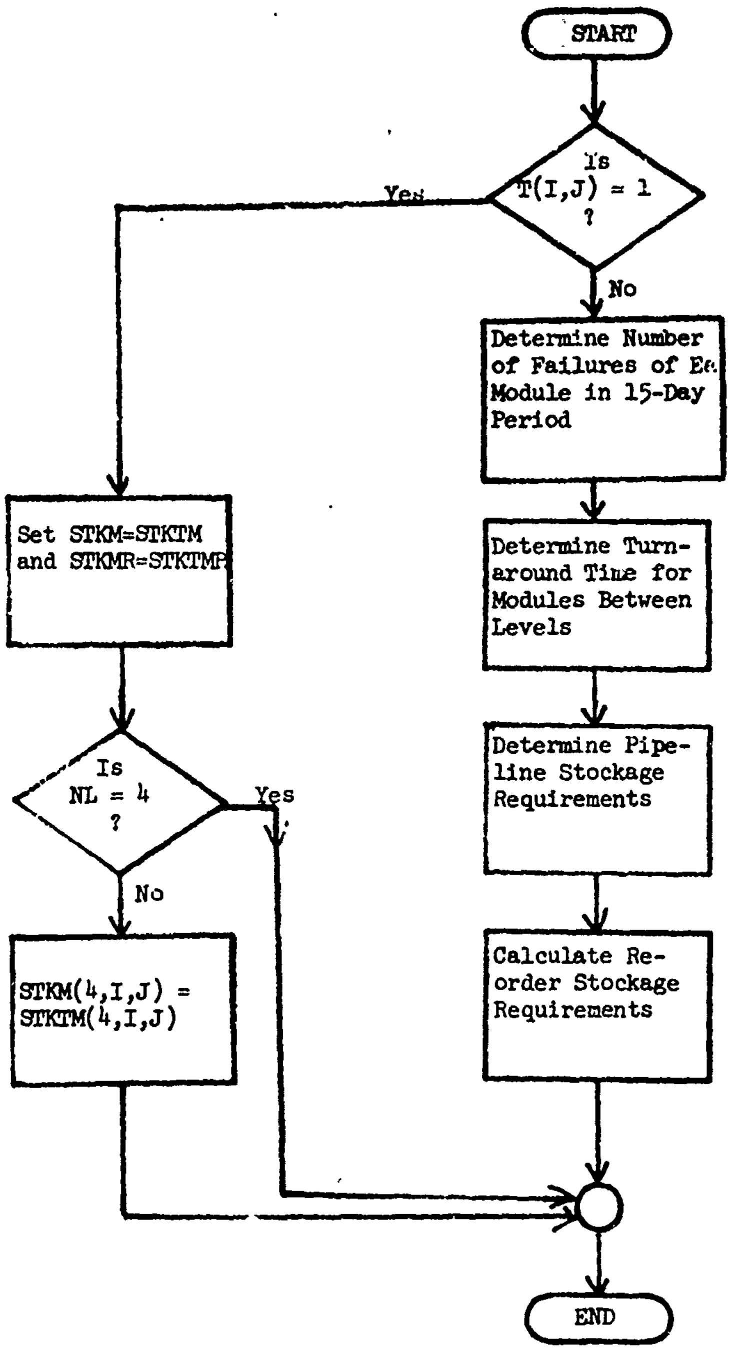
SUBROUTINE THRCOM



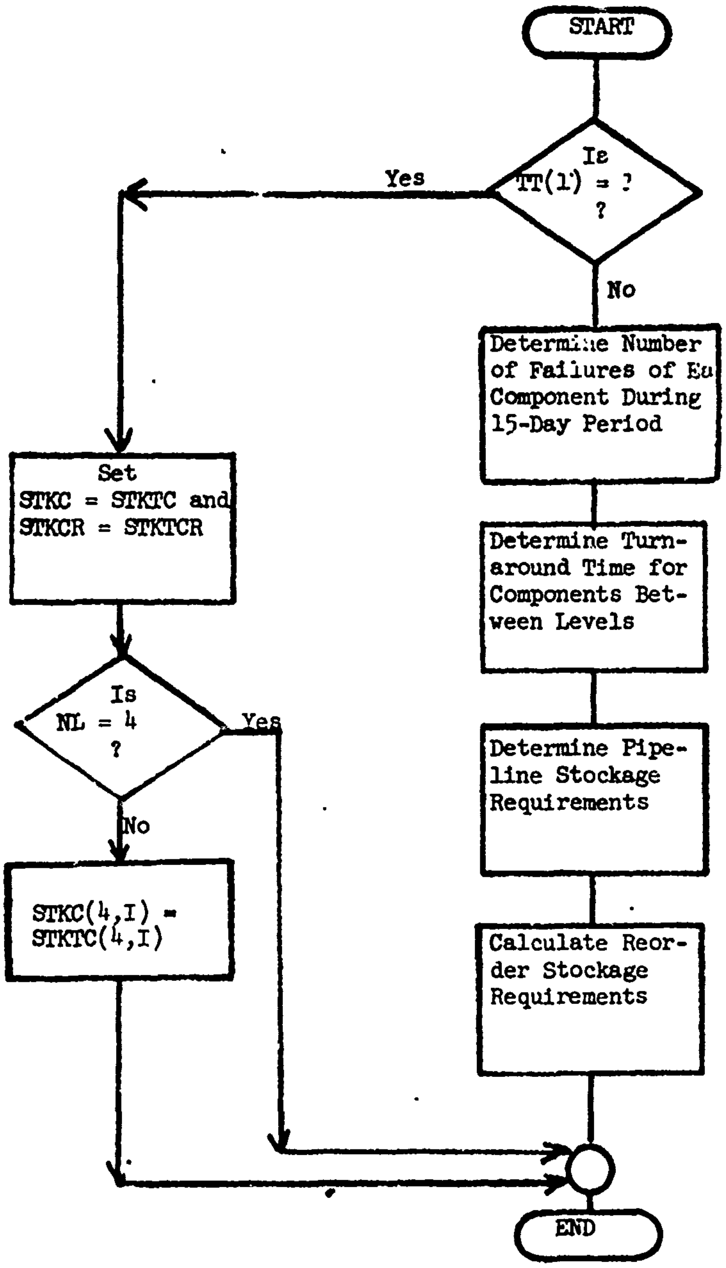
SUBROUTINE NONREP



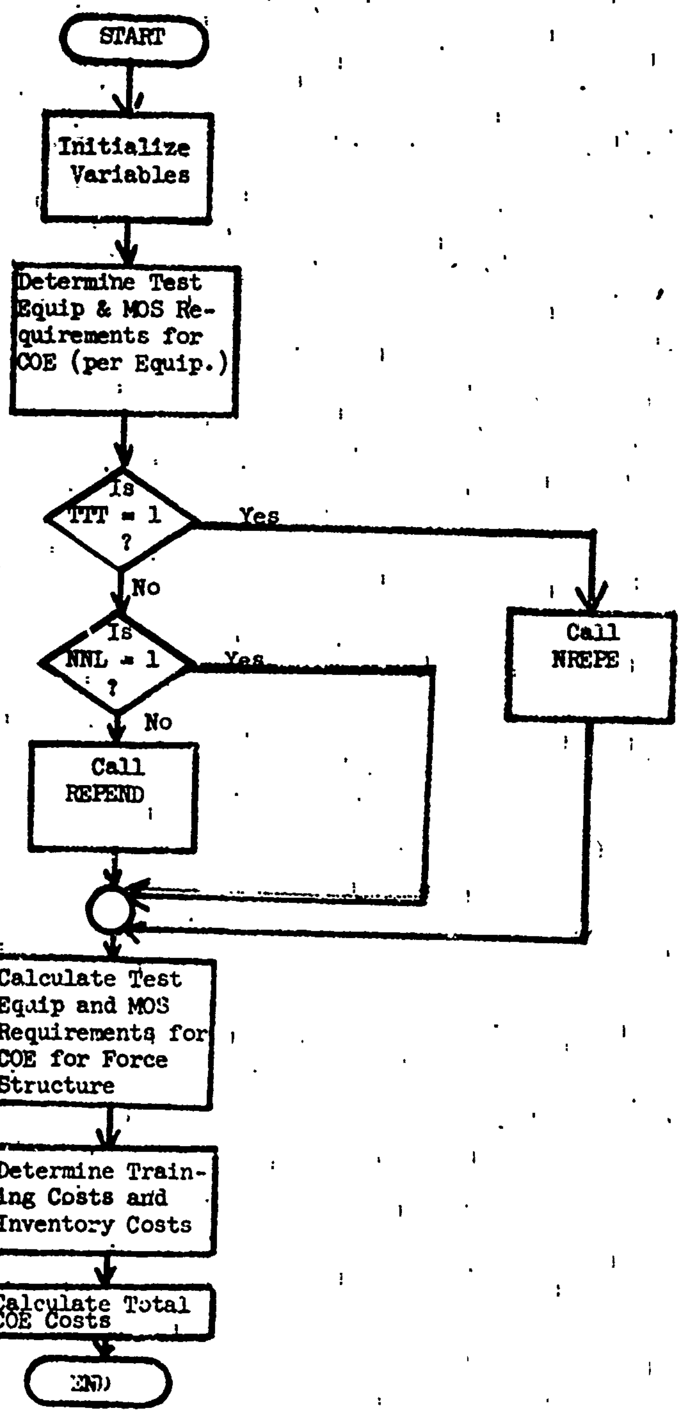
SUBROUTINE REPMOD



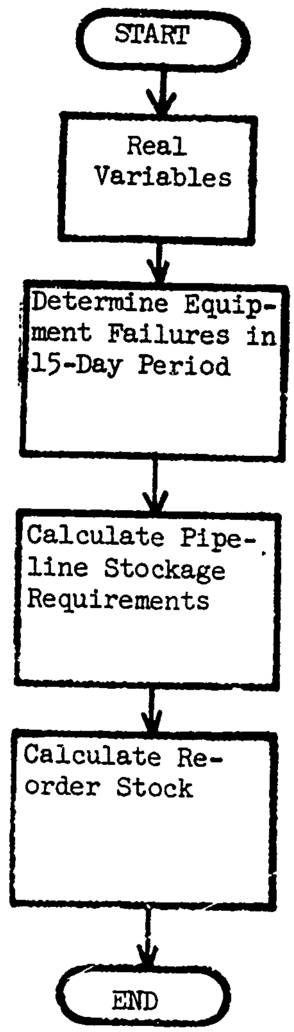
SUBROUTINE REPCOM



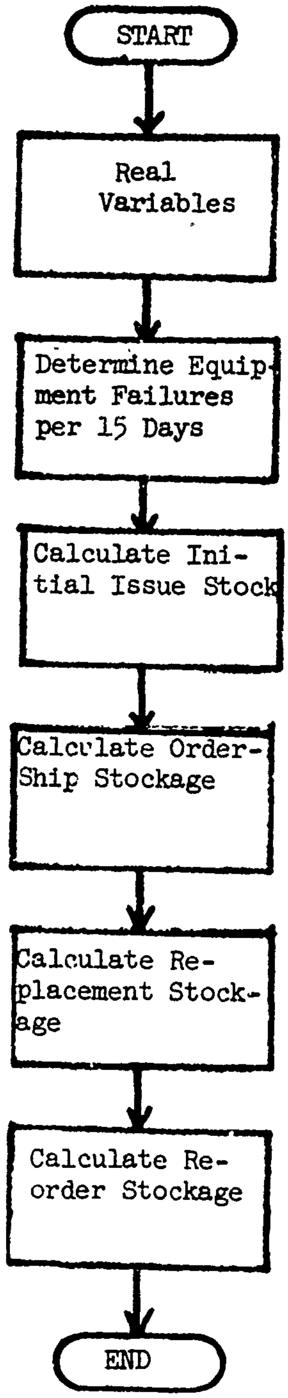
SUBROUTINE XCOE



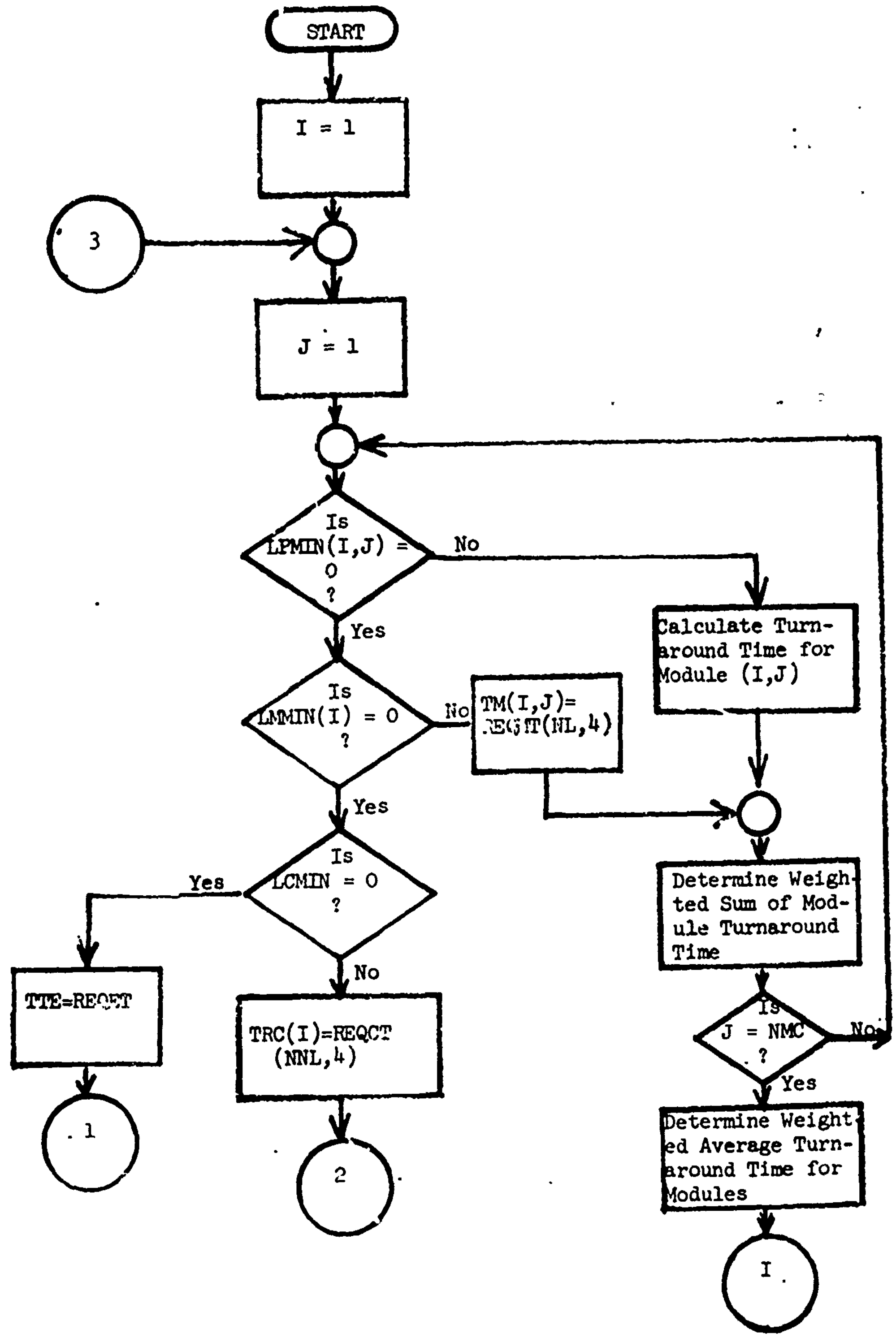
SUBROUTINE REPEND

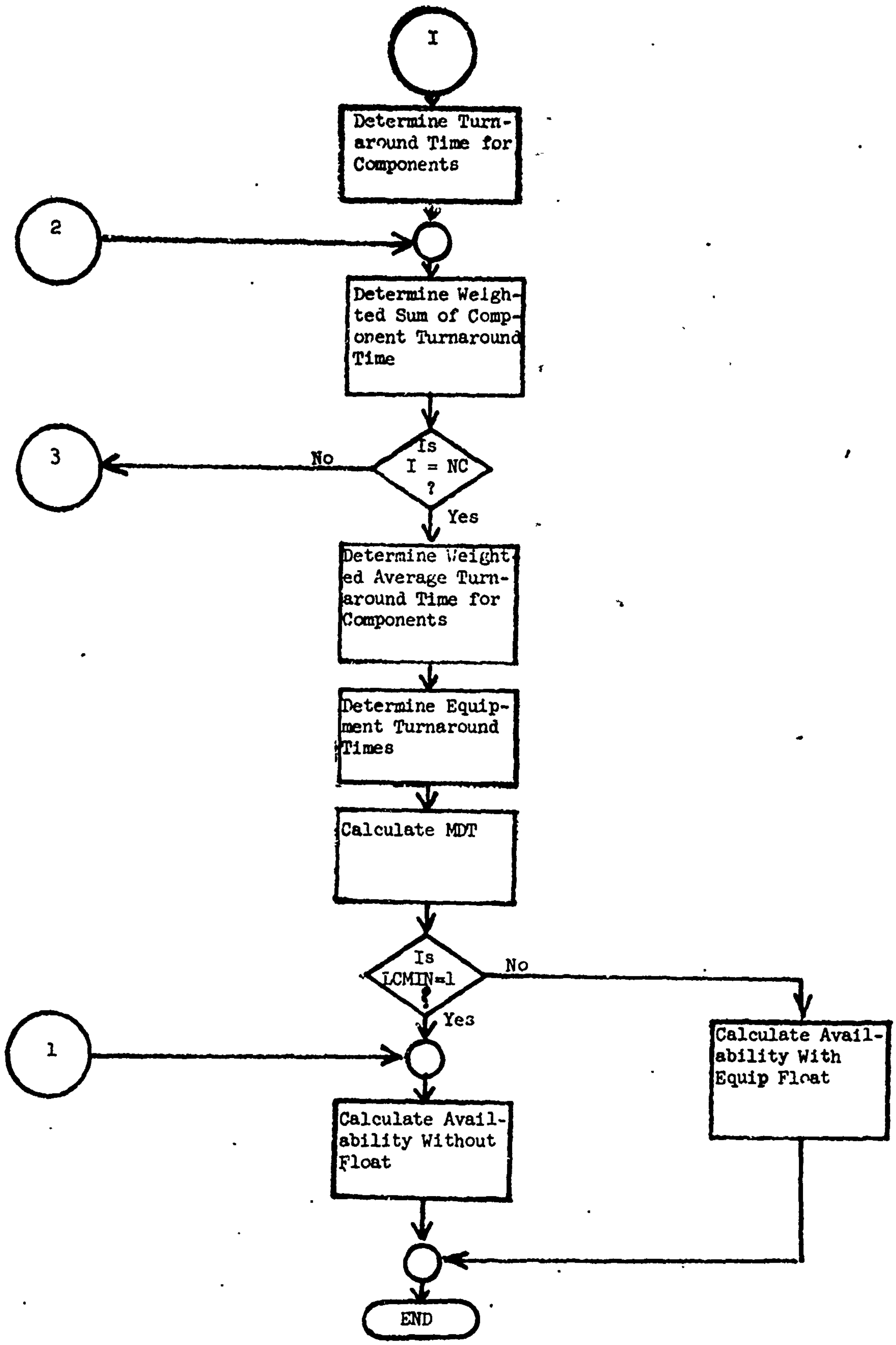


SUBROUTINE NREPE

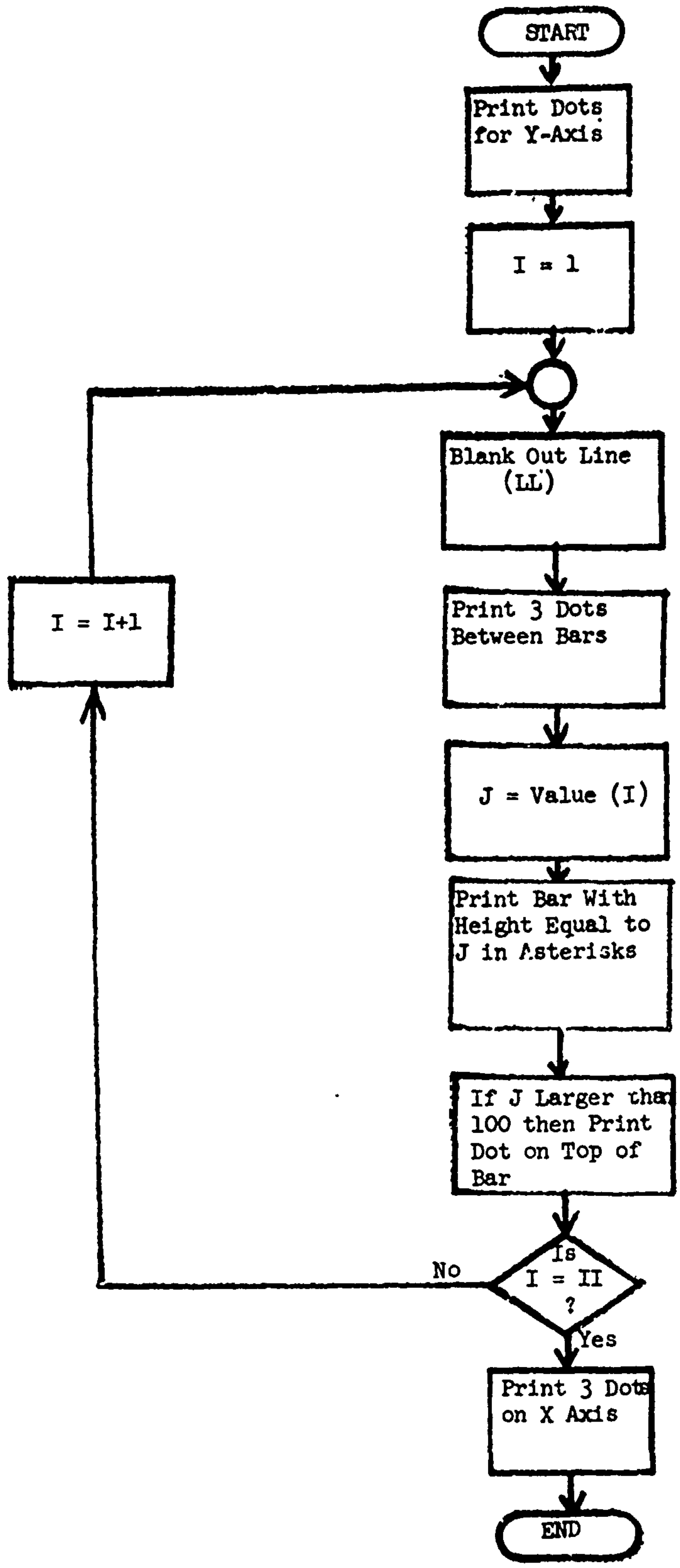


SUBROUTINE AVAIL




I
Determine Turn-around Time for Components
2
Determine Weighted Sum of Component Turnaround Time
3
No
Is I = NC ?
Yes
Determine Weighted Average Turn-around Time for Components
Determine Equipment Turnaround Times
Calculate MDT
Is LCMIN=1 ?
No
Yes
1
Calculate Availability Without Float
Calculate Availability With Equip Float
END

SUBROUTINE GRAPHA



APPENDIX D

PROGRAM LISTING

```
C   TO CHANGE NUMBER OF COMPONENTS=CHANGE ALL ELEMENTS IN GROUP 1,      00005850 R  0048
C         AND THE 1ST ELEMENTS IN GROUPS 2,3,AND 4,                      00005851 R  0048
C         AND THE 2ND ELEMENTS IN GROUP 8.                               00005852 R  0048
C   TO CHANGE NUMBER OF MODULES=CHANGE 2ND ELEMENTS IN GROUP 2,          00005853 R  0048
C         AND THE 3RD ELEMENTS IN GROUP 8.                               00005854 R  0048
C   TO CHANGE NUMBER OF PARTS=CHANGE 3RD ELEMENT OF "NUMBR"              00005855 R  0048
C         IN GROUP 2,                                                    00005856 R  0048
C         AND ALL ELEMENTS IN GROUP 5,                                   00005857 R  0048
C         AND 2ND ELEMENTS IN GROUP 9.                                   00005858 R  0048
C   TO CHANGE NUMBER OF TEST EQUIPMENTS=CHANGE 3RD ELEMENT               00005859 R  0048
C         IN "TEMI" IN GROUP 2,                                          00005860 R  0048
C         AND 2ND ELEMENTS IN GROUP 3,                                   00005861 R  0048
C         AND ALL ELEMENTS IN GROUP 6,                                   00005862 R  0048
C         AND 2ND ELEMENTS IN GROUP 10.                                  00005863 R  0048
C   TO CHANGE NUMBER OF MUS=CHANGE 3RD ELEMENT IN "MOSM"                 00005864 R  0048
C         IN GROUP 2,                                                    00005865 R  0048
C         AND 2ND ELEMENTS IN GROUP 4,                                   00005866 R  0048
C         AND ALL ELEMENTS IN GROUP 7,                                   00005867 R  0048
C         AND 2ND ELEMENTS IN GROUP 11.                                  00005868 R  0048
```

```
C     GROUP 1                                                        00005899 R  0048
                                                                START OF SEGMENT ********
      DIMENSION AMMHC(4),CCC(4),CSTC(4),CSTRNC(4),CTUC(4),           00005900 R  0000
     *FICZ(4),FIMS(4),FIMI(4),LMMIN(4),LMS(4),MOSCM(4),MTBFC(4),     00006000 R  0000
     *MTTRC(4),NMK(4),NUFAIC(4),PGM(4),PUBM(4),REPCT(4),             00006100 R  0000
     *STCM(4),STKCR(4),STKTCR(4),TBDC(4),TECM(4),TOTCSM(4),          00006200 R  0000
     *TRANTC(4),TRC(4),TT(4),TTM(4),WTC(4)                           00006300 R  0000
C     GROUP 2                                                        00006399 R  0000
      DIMENSION AMMHM(4,22),CC(4,22),CSTM(4,22),CSTRNM(4,22),        00006400 R  0000
     *CTOM(4,22),                                                    00006450 R  0000
     *FIMZ(4,22),FIPS(4,22),FIPT(4,22),LPMIN(4,22),LPP(4,22),        00006500 R  0000

     *LPS(4,22),MUSCP(4,22),MOSM(4,22,10),MTBFM(4,22),MTTRM(4,22),   00006600 R  0000
     *NUFAIL(4,22),NUMBR(4,22,38),PGP(4,22),PURP(4,22),              00006700 R  0000
     *REPMT(4,22),STCP(4,22),STKMR(4,22),STKTMR(4,22),T(4,22),       00006800 R  0000
     *TBOM(4,22),                                                    00006850 R  0000
     *TECP(4,22),TEMI(4,22,40),TM(4,22),TUTCSP(4,22,4),              00006900 R  0000
     *TRANTM(4,22),WIM(4,22)                                         00007000 R  0000
```

```
C     GROUP 3                                                            00007099 R  0000
        DIMENSION TECI(4,40)                                             00007100 R  0000
C     GROUP 4                                                            00007199 R  0000
        DIMENSION MOSC(4,22)                                             00007200 R  0000
C     GROUP 5                                                            00007299 R  0000
        DIMENSION C(38),HIBFP(38),ST(38),ST1(38),ST2(38),ST3(38),        00007300 R  0000
      *STP(38)                                                           00007400 R  0000
C     GROUP 6                                                            00007499 R  0000
        DIMENSION NLEV(40),NNUM(40),NUM(40),TECL(40),TEET(40),           00007500 R  0000
      *TECOST(40)                                                        00007600 R  0000
C     GROUP 7                                                            00007699 R  0000
        DIMENSION MLEV(10),MMNUM(10),MNUM(10),MOSCE(10),MOSE(10),        00007700 R  0000
      *YMAN(10)                                                          00007800 R  0000
C     GROUP 8                                                            00007899 R  0000
        DIMENSION CSTKC(4,4),CSTKM(4,4,22),STKC(4,4),STKM(4,4,22),       00007900 R  0000
      *STKTC(4,4),STKTM(4,4,22)                                          00008000 R  0000
```

```
C     GROUP 9                                                          00008099 R  0000
        DIMENSION CSTK(4,38),STK(4,38)                                 00008100 R  0000
C     GROUP 10                                                         00008199 R  0000
        DIMENSION CNNLEV(4,40),NCLEV(4,40),NILEV(4,40),NNLEV(4,40),    00008200 R  0000
       *TE(4,40)                                                       00008300 R  0000
C     GROUP 11                                                         00008399 R  0000
        DIMENSION CHMLEV(4,10),HCLEV(4,10),MCOSI(4,10),                00008400 R  0000
       *MILEV(4,10),MMLEV(4,10),MUS(4,10)                              00008410 R  0000
C     GROUP 12                                                         00008419 R  0000
        DIMENSION B(4),CUSLB(4,4),G(4),NSHIP(4),NUMFS(4),              00008420 R  0000

       *OPHRSH(4),REQCI(4,4),REQMT(4,4),REQPT(4,4),TRAIN(4),           00008430 R  0000
       *TRANS(4,4),TRANST(4,4),TURN1(4),TURN2(4),WAIT(4)               00008440 R  0000
C     GROUP 13                                                         00008449 R  0000
        DIMENSION CUE(35),FIC(35),FIM(35),FIP(35),H(35)                00008450 R  0000
```

```
C    GROUP 14                                                          00008459 R  0000
      DIMENSION GAVAL(40),GCOST(40),GCSTE(40)                          00008460 R  0000
      INTEGER FIC, SENS,TECE,TEEI,TECI,TEMI,I,TT,TTT,FIP,FIM,P,R       00008520 R  0000
      DATA CDE/35*1/                                                   00008600 R  0000
      DATA FIC/15*1,10*2,6*3,3*4,0/                                    00008700 R  0012
      DATA FIM/5*1,4*2,3*3,2*4,0,4*2,3*3,2*4,0,3*3,2*4,0,4,4,2*0/          8800 R  0024
      DATA FIP/1,2,3,4,0,2,3,4,0,3,4,0,4,0,0,2,3,4,0,                      9000 R  0036
     *3,4,0,4,0,0,3,4,0,4,0,0,4,0,0,0/                                     9100 R  0044
      DATA STK/152*0./                                                 00009200 R  0048
      DATA TE/160*0./                                                  00009300 R  0060
      REAL MTTRCF,MTTRE,MTTRM,MTTRC,MTBFE,MTBFC,MTBFM,MTBFP,NSHOP,         9400 R  0072
     *MCOST,LAMCUM,NUMBR,MOS,MOSCP,K1,K2,K3,MOSCM,MOSCC                    9500 R  0072
      REAL NLEV,NUM,MLEV,MNUM,NNLEV,MMLEV,MCLEV,NCLEV,MNNUM,NNUM           9600 R  0072
      REAL NUMFS,MOSEC                                                 00009640 R  0072
      REAL NDAE,NDAY                                                   00009645 R  0072
      DATA MOS/40*0./                                                  00009650 R  0072
```

```
      CALL TIMEON                                              9900 R  0084
      TI=0                                                    10000 R  0084
      WRITE(6,8010)                                           10100 R  0085
 8010 FORMAT(40X,17HINPUT INFORMATION//)                      10200 R  0089
      READ(5,1950)NC,NCLASP                                   10300 R  0089
 1950 FORMAT(10I3/10I3)                                       10400 R  0101
      WRITE(6,8011)NC,NCLASP                                  10500 R  0101
 8011 FORMAT(30X,3HNC=,I3,7HNCLASP=,I3)                       10600 R  0113
      READ(5,1950)(NMK(I),I=1,NC)                             10700 R  0113
      WRITE(6,8012)(NMK(I),I=1,NC)                            10800 R  0130
 8012 FORMAT(30X,15HNMK(COMPONENT)=,10I3)                     10900 R  0147
      DO 1952 I=1,NC                                          11000 R  0147

      NMC=NMK(I)                                              11100 R  0152
      DO 1952 J=1,NMC                                         11200 R  0154
      READ(5,113) (NUMBR(I,J,KS),KS=1,NCLASP)                 11300 R  0159
```

```
  113 FORMAT (20F3.0)                                              11400 R  0182
      WRITE(6,8013)(NUMBR(I,J,KS),KS=1,NCLASP)                     11500 R  0182
 8013 FORMAT(30X,25HNUMBR(COMP,MODULE,CLASS)=,15F5.0)              11600 R  0204
 1952 CONTINUE                                                     11700 R  0204
 1330 CONTINUE                                                     11800 R  0205
      READ(5,213)(MTBFP(K),K=1,NCLASP)                             11900 R  0205
      WRITE(6,8014)(MTBFP(K),K=1,NCLASP)                           12000 R  0222
 8014 FORMAT(30X,13HMTBFP(CLASS)=, 8F10.2)                         12100 R  0239
  213 FORMAT(10F8.2)                                               12200 R  0239
      READ (5,214) MTBFID                                          12300 R  0239
      WRITE(6,8015)MTBFID                                          12400 R  0248
 8015 FORMAT(30X,7HMTBFID=,I2)                                     12500 R  0259
  214 FORMAT (I1)                                                  12600 R  0259
      IF (MTBFID .NE. 1) GO TO 8600                                12700 R  0259
```

```
      DO 1953 I=1,NC                                       12800 R 0261
      NMC=NMK(I)                                           12900 R 0266
      READ(5,213)(MTBFM(I,J),J=1,NMC)                      13000 R 0268
 1953 WRITE(6,8016)(MTBFM(I,J),J=1,NMC)                    13100 R 0286
 8016 FORMAT(30X,19HMTBFM(COMP,MODULE)=,10F8.2)            13200 R 0305
      READ(5,213)(MTBFC(I),I=1,NC)                         13300 R 0305
      WRITE(6,8017)(MTBFC(I),I=1,NC)                       13400 R 0322
 8017 FORMAT(30X,12HMTBFC(COMP)=,10F8.2)                   13500 R 0339
      READ(5,222)MTBFE                                     13600 R 0339
      WRITE(6,8018)MTBFE                                   13700 R 0348
 8018 FORMAT(30X,6HMTBFE=,F8.2)                            13800 R 0359
  222 FORMAT (F10.5)                                       13900 R 0359
 1979 FORMAT(I3)                                           14000 R 0359
      GO TO 1957                                           14100 R 0359
 8600 CONTINUE                                             14200 R 0360
```

```
      CALL MTBFMD(NC,NMK,NCLASP,MTBFP,NUMBR,MTBFM,MTBFID)         14300 R  0360
      CALL MTBFCM(NC,NMK,MTBFM,MTBFC,MTBFID)                      14400 R  0366
      CALL MTBFEQ(NC,MTBFC,MTBFE,MTBFID)                          14500 R  0370
 1957 CONTINUE                                                    14600 R  0373
      IF(IT.NE.0) GO TO 1981                                      14700 R  0373
 1331 CONTINUE                                                    14800 R  0376
      READ(5,1955) MITRCE,MTTRE                                   14900 R  0376
      WRITE(6,8019) MITRCE,MTTRE                                  15000 R  0387
 8019 FORMAT(30X,7HMITRCE=,F6.2,6HMTTRE=,F6.2)                    15100 R  0400
      READ(5,1955)(MITRC(I),I=1,NC)                               15200 R  0400
      WRITE(6,8020)(MITRC(I),I=1,NC)                              15300 R  0417
 8020 FORMAT(30X,12HMITRC(COMP)=,10F6.2)                          15400 R  0434
      DO 1956 I=1,NC                                              15500 R  0434
      NMC=NMK(I)                                                  15600 R  0439
      READ(5,1955)(MITRM(I,J),J=1,NMC)                            15700 R  0441
```

```
      WRITE(6,8021)(MITRM(I,J),J=1,NMC)                               15800 R  0459
 8021 FORMAT(30X,19HMITRM(COMP,MODULE)=,10F10.2)                      15900 R  0477
                                                            SEGMENT    5 IS  1
 1956 CONTINUE                                                        16000 R  0477
      IF(IT.NE.0) GO TO 1981                                          16100 R  0477
 1955 FORMAT(10F6.2/10F6.2)                                           16200 R  0480
 1332 CONTINUE                                                        16300 R  0480
      READ(5,213)CSFI                                                 16400 R  0480
      WRITE(6,8022)CSFI                                               16500 R  0489
 8022 FORMAT(30X,5HCSFI=,F8.2)                                        16600 R  0500
      READ(5,213)(CCC(I),I=1,NC)                                      16700 R  0500
      WRITE(6,8023)(CCC(I),I=1,NC)                                    16800 R  0517
 8023 FORMAT(30X,10HCCC(COMP)=,10F8.2)                                16900 R  0534
      DO 1960 I=1,NC                                                  17000 R  0534
      NMC=NMK(I)                                                      17100 R  0539
      READ(5,213)(CC(I,J),J=1,NMC)                                    17200 R  0541
      WRITE(6,8024)(CC(I,J),J=1,NMC)                                  17300 R  0559
```

```
 1960 CONTINUE                                          17400 R   0577
 8024 FORMAT(30X,16HCC(COMP,MODULE)=,10F8.2)            17500 R   0578
      READ(5,213)(C(K),K=1,NCLASP)                      17600 R   0578
      WRITE(6,8025)(C(K),K=1,NCLASP)                    17700 R   0595
 8025 FORMAT(30X,9HC(CLASS)=,10F8.2)                    17800 R   0612
      IF(IT.NE.0) GO TO 1981                            17900 R   0612
 1333 CONTINUE                                          18000 R   0615
      READ(5,1950)NTE                                   18100 R   0615
      WRITE(6,8026)NTE                                  18200 R   0624
 8026 FORMAT(30X,4HNTE=,I3)                             18300 R   0635
      READ(5,103)(TECE(K),K=1,NTE)                      18400 R   0635
      WRITE(6,8027)(IECE(K),K=1,NTE)                    18500 R   0652
 8027 FORMAT(30X,11HIECE(TYPE)=,40I1)                   18600 R   0669
      READ(5,103)(TEEI(K),K=1,NTE)                      18700 R   0669
      WRITE(6,8028)(IEEI(K),K=1,NTE)                    18800 R   0686
 8028 FORMAT(30X,11HIEEI(TYPE)=,40I1)                   18900 R   0703
      DO 1961 I=1,NC                                    19000 R   0703
```

```
      READ(5,103)(TECI(I,KK),KK=1,NTE)                          19100 R  0708
      WRITE(6,8029)(IECI(I,KK),KK=1,NTE)                        19200 R  0727
 8029 FORMAT(30X,16HIECI(COMP,TYPE)=,40I1)                      19300 R  0745
  103 FORMAT (40I1)                                             19400 R  0745
 1961 CONTINUE                                                  19500 R  0745
      DO 1962 I=1,NC                                            19600 R  0745
      NMC=NMK(I)                                                19700 R  0750
      DO 1962 J=1,NMC                                           19800 R  0752
      READ(5,103) (TEMI(I,J,KK),KK=1,NTE)                       19900 R  0757
      WRITE(6,8030)(IEMI(I,J,KK),KK=1,NTE)                      20000 R  0780
 8030 FORMAT(30X,23HIEMI(COMP,MODULE,TYPE)=,40I1)               20100 R  0802
 1962 CONTINUE                                                  20200 R  0802
      READ(5,213)(TECUST(KK),KK=1,NTE)                          20300 R  0803
      WRITE(6,8031)(IECUSI(KK),KK=1,NTE)                        20400 R  0820
 8031 FORMAT(30X,13HIECUSI(TYPE)=,10F8.2)                       20500 R  0837
```

```
      IF(II.NE.0) GO TO 1981                                20600 R  0837
 1334 CONTINUE                                              20700 R  0840
      READ(5,1950)NMUS                                      20800 R  0840
      WRITE(6,8032)NMUS                                     20900 R  0849
 8032 FORMAT(30X,5HNMUS=,I3)                                21000 R  0860
      READ(5,104)(MUSCE(KM),KM=1,NMUS)                      21100 R  0860
      WRITE(6,8033)(MUSCE(KM),KM=1,NMUS)                    21200 R  0877
 8033 FORMAT(30X,12HMUSCE(TYPE)=,40I1)                      21300 R  0894
      READ(5,104)(MUSE(KM),KM=1,NMUS)                       21400 R  0894
      WRITE(6,8034)(MUSE(KM),KM=1,NMUS)                     21500 R  0911
 8034 FORMAT(30X,11HMUSE(TYPE)=,40I1)                       21600 R  0928
      DO 1963 I=1,NC                                        21700 R  0928
      READ(5,104)(MUSC(I,KM),KM=1,NMUS)                     21800 R  0933
      WRITE(6,8035)(MUSC(I,KM),KM=1,NMUS)                   21900 R  0952
 8035 FORMAT(30X,16HMUSC(COMP,TYPE)=,40I1)                  22000 R  0970
```

```
1963 CONTINUE                                              22100 R  0970
     DO 1964 I=1,NC                                        22200 R  0970
     NMC=NMK(I)                                            22300 R  0975
     DO 1964 J=1,NMC                                       22400 R  0977
     READ(5,104) (MUSM(I,J,KM),KM=1,NMOS)                  22500 R  0982
     WRITE(6,8036)(MUSM(I,J,KM),KM=1,NMOS)                 22600 R  1002
8036 FORMAT(30X,23HMUSM(COMP,MODULE,TYPE)=,40I1)           22700 R  1021
 104 FORMAT (10I1)                                         22800 R  1021
1964 CONTINUE                                              22900 R  1021
     DO 6439 L=1,4                                         23000 R  1022
                                                      SEGMENT    4 IS 10:
                                                START OF SEGMENT *********
     READ(5,213)(MCOST(L,KM),KM=1,NMOS)                    23100 R  0005
6439 WRITE(6,8037)(MCOST(L,KM),KM=1,NMOS)                  23200 R  0024
8037 FORMAT(30X,12HMCOST(TYPE)=,10F8.2)                    23300 R  0043
     IF(IT.NE.0) GO TO 1981                                23400 R  0043
1335 CONTINUE                                              23500 R  0046
```

```
      READ(5,1974)WTE                                          23600 R  0046
      WRITE(6,8036)WTE                                         23700 R  0055
 8036 FORMAT(30X,4HWTE=,F12.2)                                 23800 R  0066
      READ(5,1974)(WIC(I),I=1,NC)                              23900 R  0066
      WRITE(6,8039)(WIC(I),I=1,NC)                             24000 R  0083
 8039 FORMAT(30X,10HWIC(CUMP)=,10F7.2)                         24100 R  0100
                                                          SEGMENT    7 IS  1
      DO 1975 I=1,NC                                           24200 R  0100
      NMC=NMK(I)                                               24300 R  0105
      READ(5,1974)(WIM(I,J),J=1,NMC)                           24400 R  0107
      WRITE(6,8040)(WIM(I,J),J=1,NMC)                          24500 R  0125
 1975 CONTINUE                                                 24600 R  0143
 8040 FORMAT(30X,17HWIM(CUMP,MODULE)=,10F7.2)                  24700 P  0144
 1974 FORMAT(10F7.2/10F7.2)                                    24800 R  0144
      IF(IT.NE.0) GO TO 1981                                   24900 R  0144
 1336 CONTINUE                                                 25000 R  0147
```

```
      READ(5,219)(NSHUP(I),NUMFS(I),I=1,4)                          25100 R  0147
      WRITE(6,8041)(NSHUP(I),I=1,4)                                 25200 R  0167
 8041 FORMAT(30X,13HNSHUP(LEVEL)=,4F5.0)                            25300 R  0184
      WRITE(6,8042)(NUMFS(I),I=1,4)                                 25400 R  0184
 8042 FORMAT(30X,13HNUMFS(LEVEL)=,4F3.0)                            25500 R  0201
  219 FORMAT(4(F4.0,2X,F2.0))                                       25600 R  0201
      IF(IT.NE.0) GO TO 1981                                        25700 R  0201
 1337 CONTINUE                                                      25800 R  0204
      READ(5,216)((TRANST(L,NL),COSLR(L,NL),L=NL,4),NL=1,4)         25900 R  0204
      WRITE(6,8043)((TRANST(L,NL),L=NL,4),NL=1,4)                   26000 R  0233
 8043 FORMAT(30X,25HTRANST(LEVEL,NEXT LEVEL)=,10F7.0)               26100 R  0258
      READ(5,5998)((TRANS(L,NL),L=NL,4),NL=1,4)                     26200 R  0258
      WRITE(6,5999)((TRANS(L,NL),L=NL,4),NL=1,4)                    26300 R  0283
 5998 FORMAT(10 F5.2)                                               26400 R  0308
 5999 FORMAT(30X,24HTRANS(LEVEL,NEXT LEVEL)=,10F7.2)                26500 R  0308
      WRITE(6,8044)((COSLB(L,NL),L=NL,4),NL=1,4)                    26600 R  0308
```

```
8044 FORMAT(30X,24HCUSLB(LEVEL,NEXT LEVEL)=,10F8.6)                    26700 R  0333
 216 FORMAT(5(F6.0,F7.7)/5(F6.0,F7.7))                                 26800 R  0333
     IF(II.NE.0) GO TO 1981                                            26900 R  0333
1336 CONTINUE                                                          27000 R  0336
     READ(5,1212)(REQPT(L,4),REQMT(L,4),REQCT(L,4),L=1,4)              27100 R  0336
     DO 6046 L=1,4                                                     27200 R  0359
6046 WRITE(6,8045)REQPT(L,4),REQMT(L,4),REQCT(L,4)                     27300 R  0365
8045 FORMAT(30X,14HREQPT(LEVEL,4),F4.0,14HREQMT(LEVEL(4),F4.0,15HREQCT 27400 R  0382
    *(LEVEL,4),F4.0)                                                   27500 R  0382
1212 FORMAT(3F4.0)                                                     27600 R  0382
     READ(5,213)REQET                                                  27700 R  0382
     WRITE(6,9046)REQET                                                27800 R  0391
     READ(5,213)REQ                                                 00027820 R  0401
     WRITE(6,9561)REQ                                               00027830 R  0410
9561 FORMAT(30X,4HREQ=,F10.2)                                       00027840 R  0421
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```
9046 FORMAT(30X,6HREQET=,F8.0)                                  27900 R  0421
     IF(IT.NE.0) GO TO 1981                                     28000 R  0421
     READ(5,1214)(WAIT(L),L=1,4)                                28100 R  0423
     WRITE(6,8047)(WAIT(L),L=1,4)                               28200 R  0440
8047 FORMAT(30X,12HWAIT(LEVEL)=,F6.0)                           28300 R  0457
1214 FORMAT(4(F4.0,2X))                                         28400 R  0457
1339 CONTINUE                                                   28500 R  0457
     READ(5,333)(OPHRSH(L),L=1,4)                               28600 R  0457
     WRITE(6,8048)(OPHRSH(L),L=1,4)                             28700 R  0474
8048 FORMAT(30X,14HOPHRSH(LEVEL)=,4F5.2)                        28800 R  0491
     READ(5,9563)PROD                                        00028810 R  0491
9563 FORMAT(F8.4)                                            00028820 R  0501
     WRITE (6,9567)PROD                                      00028830 R  0501
9567 FORMAT(30X,18HPRODUCTIVE FACTOR=,F8.4)                  00028840 R  0511
     IF(IT.NE.0) GO TO 1981                                     28900 R  0511
1340 CONTINUE                                                   29000 R  0514
     READ(5,1951)K1,K2,K3,XK4,TK1,TK2,TK3,TK4,PENGO,ATRF,RUP    29100 R  0514
```

```
1951 FORMAT(10F4.3,F3.0)                                                R  0544
                                                               SEGMENT  R IS  1:
     WRITE(6,8049)K1,K2,K3,XK4,TK1,TK2,TK3,TK4,PENGU,ATRF,ROP           R  0544
8049 FORMAT(30X,3HK1=,F5.2,3HK2=,F5.2,3HK3=,F5.2,4HXK4=,F5.2,4HTK1=,F5. R  0574
    *2,4HTK2=,F5.2,4HTK3=,F5.2,4HTK4=,F5.2,6HPENGU=,F5.2,5HATRF=,F5.2,  R  0574
    *4HROP=,F3.0)                                                       R  0574
     IF(IT.NE.0) GO TO 1981                                             F  0574
1341 CONTINUE                                                           R  0577
     READ(5,333)(R(I),G(I),TURN1(I),TURN2(I),I=1,4)                     R  0577
     DO 8051 I=1,4                                                      R  0603
8051 WRITE(6,8050)R(I),G(I),TURN1(I),TURN2(I)                           R  0609
8050 FORMAT(30X,9HR(LEVEL)=,F5.2,9HG(LEVEL)=,F5.2,13HTURN1(LEVEL)=,F5.2 R  0629
    *,13HTURN2(LEVEL)=,F5.2)                                            R  0629
     IF(IT.NE.0) GO TO 1981                                             R  0629
 333 FORMAT (4(F5.2))                                                   R  0632
```

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1342  CONTINUE                                                    30600 R  0632
      READ(5,1970)ELIFE                                           30700 R  0632
      WRITE(6,8052)ELIFE                                          30800 R  0681
 8052 FORMAT(30X,6HELIFE=,F5.2)                                   30900 R  0652
      READ(5,1983)NDAY,UPHRDY,NDAE                                31000 R  0652
      WRITE(6,8053)NDAY,UPHRDY,NDAE                               31100 R  0665
 8053 FORMAT(30X,5HNDAY=,F5.0,7HUPHRDY=,F5.0,5HNDAE=,F5.0)        31200 R  0680
 1983 FORMAT(3(F3.0))                                             31300 R  0680
      IF(II.NE.0) GO TO 1981                                      31400 R  0680
 1970 FORMAT(F5.2)                                                31500 R  0683
 1343 CONTINUE                                                    31600 R  0683
      READ(5,1310)(XMAN(KM),KM=1,NMUS)                            31700 R  0683
      WRITE(6,8054)(XMAN(KM),KM=1,NMUS)                           31800 R  0700
 8054 FORMAT(30X,10HXMAN(MUS)=,10F8.0)                            31900 R  0717
      IF(II.NE.0) GO TO 1981                                      32000 R  0717
 1310 FORMAT(10(2X,F5.0))                                         32100 R  0720
 1344 CONTINUE                                                    32200 R  0720
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      READ(5,1972)FACTIN,(TRAIN(L),L=1,4),DMF                         32300 R  0720
      WRITE(6,7792)FACTIN,(TRAIN(L),L=1,4),DMF                        32400 R  0741
7792 FORMAT(30X,7HFACTIN=,F7.4,13HTRAIN(LEVEL)=,4F6.2,4HDMF=,F6.2)    32500 R  0764
      IF(IT.NE.0) GO TO 1981                                          32600 R  0764
1972 FORMAT(F5.3,5F4.2)                                               32700 R  0767
      READ(5,214) KNOWN                                               32800 R  0767
      WRITE(6,8056)KNOWN                                              32900 R  0776
8056 FORMAT(30X,6HKNOWN=,I3)                                          33000 R  0787
      IF(KNOWN.EQ.0) GO TO 1450                                       33100 R  0787
1345 CONTINUE                                                         33200 R  0790
      READ(5,214) LCMIN                                               33300 R  0790
      WRITE(6,8057)LCMIN                                              33400 R  0799
8057 FORMAT(30X,6HLCMIN=,I3)                                          33500 R  0810
      WRITE(6,8969)PUC                                              00033520 R  0810
      READ(5,103) (LMMIN(I),I=1,NC)                                   33600 R  0819
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      WRITE(6,8058)(LMMIN(I),I=1,NC)                          33700 R  0836
 8058 FORMAT(30X,12HLMMIN(COMP)=,10I2)                        33800 R  0853
      DO 1451 I=1,NC                                          33900 R  0853
      NMC=NMK(I)                                              34000 R  0858
      READ(5,103)(LPMIN(I,J),J=1,NMC)                         34100 R  0860
      WRITE(6,8059)(LPMIN(I,J),J=1,NMC)                       34200 R  0878
 8059 FORMAT(30X,19HLPMIN(COMP,MODULE)=,10I2)                 34300 R  0896
 1451 CONTINUE                                                34400 R  0896
      IF(II.NE.0) GO TO 1981                                  34500 R  0896
      GO TO 1491                                              34600 R  0898
 1450 CONTINUE                                                34700 R  0900
 1432 READ(5,212)MMAX,(R(M),M=1,MMAX)                         34800 R  0900
      WRITE(6,8060)(R(M),M=1,MMAX)                            34900 R  0919
 8060 FORMAT(30X,8HPOLICIES,3X,35I2)                          35000 R  0936
                                                        SEGMENT    9 IS  123
  212 FORMAT( I2,35I2)                                        35100 R  0936
      IF(II.NE.0) GO TO 1981                                  35200 R  0936
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1491 CONTINUE                                                      35300 R  0939
1726 READ(5,3705)RANDD                                             35400 R  0939
     WRITE(6,3706)RANDD                                            35500 R  0948
     READ(5,3705)PDC                                             00035510 P  0958
     WRITE(6,8969)PDC                                            00035520 P  0968
8969 FORMAT(30X,16HPRODUCTION COST=,F13.2)                       00035530 R  0979
3705 FORMAT(F12.2)                                                 35600 R  0979
3706 FORMAT(30X,30HRESEARCH AND DEVELOPMENT COST ,F13.2)           35700 R  0979
     IF(IT.NE.0) GO TO 1981                                        35800 R  0979
1346 READ(5,214)IRD                                                35900 R  0982
     WRITE(6,8065)IRD                                              36000 R  0991
8065 FORMAT(30X,15HROUND UP  EQUAL ,I2)                            36100 R  1002
     IF(IT.NE.0) GO TO 1981                                        36200 R  1002
1379 READ(5,1974)PPC                                               36300 R  1005
     WRITE(6,7824)PPC                                              36400 R  1014
                                                          SEGMENT    6 IS 102
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```
                                                              START OF SEGMENT **********
7824 FORMAT(30X,4HPPC=,F6.2)                                       36500 R  0006
                                                              SEGMENT  11 IS
      READ(5,7318)PGC,PGE                                          36600 R  0006
      WRITE(6,7787)PGC,PGE                                         36700 P  0017
7787 FORMAT(30X,4HPGC=,F6.2,4HPGE=,F6.2)                           36800 R  0030
      READ(5,7217)(PGM(I),I=1,NC)                                  36900 R  0030
      WRITE(6,7982)(PGM(I),I=1,NC)                                 37000 R  0047
7982 FORMAT(30X,10HPGM(CUMF)=,10F6.2)                              37100 R  0064
      DO 7317 I=1,NC                                               37200 R  0064
      NMC=NMK(I)                                                   37300 R  0069
      READ(5,7217)(PGP(I,J),J=1,NMC)                               37400 R  0071
7317 WRITE(6,7983)(PGP(I,J),J=1,NMC)                               37500 R  0089
7983 FORMAT(30X,17HPGP(CUMP,MODULE)=,10F6.2)                       37600 R  0108
7217 FORMAT(10F5.0/10F5.0)                                         37700 R  0108
7318 FORMAT(2F5.0)                                                 37800 R  0108
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      IF(II.NE.0) GO TO 1981                                37900 R   0108
 7731 READ(5,213)CTUE                                    00037902 R   0111
      WRITE(6,8314)CTUE                                  00037904 R   0120
      READ(5,213)(CTUC(I),I=1,NC)                        00037906 R   0130
      WRITE(6,8315)(CTUC(I),I=1,NC)                      00037908 R   0147
      DO 8316 I=1,NC                                     00037910 R   0164
      NMC=NMK(I)                                         00037912 R   0169
      READ(5,213)(CTUM(I,J),J=1,NMC)                     00037914 R   0171
 8316 WRITE(6,8317)(CTUM(I,J),J=1,NMC)                   00037916 R   0189
 8314 FORMAT(30X,5HCTUE=,F10.2)                          00037918 R   0208
 8315 FORMAT(30X,11HCTUC(COMP)=,8F10.2)                  00037920 R   0208
 8317 FORMAT(30X,15HCTUM(COMP,MOD)=8F10.2)               00037921 R   0208
      READ(5,9217)TBUE                                   00037922 R   0208
 9217 FORMAT(20F3.0)                                     00037924 R   0218
      WRITE(6,8319)TBUE                                  00037926 R   0218
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      READ(5,9217)(TBUC(I),I=1,NC)                                           00037928 R  0227
      WRITE(6,8321)(IBOC(I),I=1,NC)                                          00037930 R  0244
      DO 8320 I=1,NC                                                         00037932 R  0261
      NMC=NMK(I)                                                             00037934 R  0266
      READ(5,9217)(THUM(I,J),J=1,NMC)                                        00037936 R  0268
 8320 WRITE(6,8322)(IBUM(I,J),J=1,NMC)                                       00037938 R  0286
 8319 FORMAT(30X,5HTBUE=,F6.2)                                               00037942 R  0305
 8321 FORMAT(30X,11HTBOC(COMP)=,10F6.2)                                      00037944 R  0305
 8322 FORMAT(30X,15HTBUM(COMP,MOD)=,10F6.2)                                  00037946 R  0305
      IF(II .NE. 0)GO TO 1981                                                00037948 R  0305
 1980 CONTINUE                                                                  38000 R  0308
C1*****CALCULATE THE ANNUAL MAINTENANCE MANHOUR REQUIREMENTS FOR THE             38100 R  0308
C      REPAIR OF EACH MODULE, EACH COMPONENT AND THE EQUIPMENT.                  38200 R  0308
      CALL ANMH(MTTRCE,MTIRE,UPHRDY,NDAY,NC,NMK,MTTRM,MTBFM,                     38300 R  0308
     *MTTRC,MTBFC,AMMHM,AMMHC,AMMHF,AMMHCE,MTBFE)                                38400 R  0312
C2*****IF VARIABLE, KNOWN, IS EQUAL TO 0, THEN OPTIMUM POLICY MUST BE            38500 R  0317
C      DETERMINED. IF KNOWN NOT EQUAL TO 0, THEN A SPECIFIED POLICY IS TO        38600 R  0317
```

```
C     BE EVALUATED (GO TO 999).                                          38700 R  0317
      IF(KNOWN.NE.0) GO TO 999                                           38800 R  0317
      SUMFMN=0.0                                                         38900 R  0319
C3*****PARAMETERS DESCRIBING THE FIP FUNCTION ARE CALCULATED BETWEEN      39000 R  0319
C     THIS POINT AND STATEMENT =98. REQUIREMENTS FOR TEST EQUIPMENT(TE), 39100 R  0319
C     MAINTENANCE PERSONNEL(MOS),PARTS STOCKAGE AND INVENTORY MANAGEMENT 39200 R  0319
C     ARE DETERMINED. TRANSPORTATION COSTS AND THE EFFECT THAT THE       39300 R  0319
C     LOCATION OF THE FIP FUNCTION WILL HAVE ON THE COST OF MODULE       39400 R  0319
C     STOCKAGE WILL BE DETERMINED LATER.                                 39500 R  0319
      DO 98 L=1,4                                                        39600 R  0320
      DO 98 I=1,NC                                                       39700 R  0325
      NMC=NMK(I)                                                         39800 R  0331
      DO 98  J=1,NMC                                                     39900 R  0333
      IF(L.EQ.4)AMMHM(I,J)=AMMHM(I,J)*(1.-DMF)                           40000 R  0338
      DO 481 KK=1,NTE                                                    40100 R  0345
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  481 TE(L,KK)=0.                                                    40200 R  0352
      DO 482 KM=1,NMUS                                               40300 R  0355
  482 MUS(L,KM)=0.                                                   40400 R  0361
      DO 39 KK=1,NTE                                                 40500 R  0364
C4*****TEMI IDENTIFIES THE TE THAT IS REQUIRED FOR THE REPAIR OF A   40600 R  0365
C      PARTICULAR MODULE.                                            40700 R  0365
      IF(TEMI(I,J,KK).NE.1) GO TO 39                                 40800 R  0369
      TE(L,KK)=AMMHM(I,J)+TE(L,KK)                                   40900 R  0377
   39 CONTINUE                                                       41000 R  0384
      DO 41 KM=1,NMUS                                                41100 R  0384
C5*****MOSM IDENTIFIES MUS FOR EACH MODULE REPAIR.                    41200 R  0385
      IF(MOSM(I,J,KM).NE.1) GO TO 41                                 41300 R  0389
      MUS(L,KM)=AMMHM(I,J)+MUS(L,KM)                                 41400 R  0394
   41 CONTINUE                                                       41500 R  0402
      TCOST=0.                                                       41600 R  0402
      DO 43 KK=1,NTE                                                 41700 R  0403
      YNLEV=TE(L,KK)/(OPHRSH(L)*NDAE)*NSHOP(L)                       41800 R  0408
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```
      NLFV(KK)=XNLEV                                       41900 R   0414
      NUM(KK)=NLFV(KK)*NUMFS(L)                            42000 R   0416
      TCOST=TCOST+NUM(KK)*TECOST(KK)                       42100 R   0419
      TECH(I,J)=TCOST                                      42200 R   0423
   43 CONTINUE                                             42300 R   0426
      TCOST=0.                                             42400 R   0426
      TRM=0.0                                              42500 R   0427
      DO 45 KM=1,NMOS                                      42600 R   0428
      PROM=PROD                                         00042650 R   0433
      IF(L.EQ.4)PROM=1.                                 00042660 R   0434
      XMLEV=MOS(L,KM)/(UPHRSH(L)*PROM*NDAE)*NSHOP(L)       42700 R   0436
      MLEV(KM)=XMLEV                                       42800 R   0442
      MNUM(KM)=MLEV(KM)*NUMFS(L)                           42900 R   0444
      TCOST=TCOST+MNUM(KM)*MCOST(L,KM)                     43000 R   0448
      TRM= MNUM(KM)*XMAN(KM)*ELIFE/TRAIN(L)+TRM            43100 R   0452
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 45 CONTINUE                                                          43200 R  0458
    MOSCP(I,J)=TCOST                                                  43300 R  0458
    TCOST=0.                                                          43400 R  0461
C6*****NONREP SUBROUTINE DETERMINES PARTS STOCKAGES REQUIRED FOR MODULE   43500 R  0461
C   REPAIR.                                                           43600 R  0461
    CALL NONREP (I,J,NCLASP,STK,NSHOP,L, OPHRDY,NDAY,NUMBR,MTBFP,NUMFS   43700 R  0462
   *,K1,B,G,ST,STR,ELIFE,ROP,ATRF)                                    43800 R  0468
    SUN=0.0                                                           43900 R  0475
    TINVIN=0.0                                                        44000 R  0475
    TINVIN=0.0                                                        44100 R  0476
    DO 47 K=1,NCLASP                                                  44200 R  0477
    TCOST=TCOST+ST(K)*C(K)                                            44300 R  0482
    STCP(I,J)=TCOST                                                   44400 R  0486
    SUN = SUN+STR(K)*C(K)                                             44500 R  0488
    TINVIN=((ST(K)-STR(K)/(ELIFE-ROP/12.))/2.+(ST(K)-STR(K)        00044600 R  0492
   */(ELIFE-ROP/12.))*(ELIFE-ROP/12.)+STR(K)/2.)*C(K)*FACTIN         00044610 R  0497
   *+TINVIN                                                        00044620 R  0504
```

```
   47 CONTINUE                                                            44700 R  0507
      PURP(I,J)=PGF(I,J)*PPC                                              44800 R  0507
C7*****TOTCSP (I,J,L) IS THE TOTAL COST FOR FIP OF EACH MODULE AT LEVEL,  44900 R  0511
C      L. (DOES NOT INCLUDE TRANSPORTATION OR EFFECT OF MODULE STOCKAGE)  45000 R  0511
      TOTCSP(I,J,L)=IECP(I,J)+MOSCP(I,J)*ELIFE+STCP(I,J)                  45100 R  0512
     *+SUM+TTINVIN+TRM +PURP(I,J)                                         45200 R  0520
   98 CONTINUE                                                            45300 R  0527
C8*****SET M=1 TO LOOK AT FIRST POLICY ON INPUT DATA CARD THAT            45400 R  0527
C      SPECIFIES THE POLICIES TO BE INVESTIGATED.                         45500 R  0527
      M=1                                                                 45600 R  0528
  998 SUMC=0.                                                             45700 R  0530
      TK =M                                                               45800 R  0530
      T=1                                                                 45900 R  0531
C9*****HAVE ALL COMPONENTS BEEN CONSIDERED, IF SO, LOOK AT EQUIPMENT      46000 R  0531
C      REPAIR (STATEMENT #6441)                                           46100 R  0531
```

```
  100 IF(I.GT.NC) GO TO 6441                                            46200 R  0533
      NMC=NMK(I)                                                        46300 R  0535
      Y = 0.                                                            46400 R  0536
      J=1                                                               46500 R  0537
C10****HAVE ALL MODULES BEEN CONSIDERED, IF SO, LOOK AT COMPONENT REPAIR 46600 R  0537
C     (STATEMENT =6442)                                                 46700 R  0537
   99 IF(J.GT.NMC) GO TO 6442                                           46800 R  0539
C11****CAUSES RETURN TO FIRST POLICY UNDER GIVEN FIM TREE.              46900 R  0540
   15 M=TP                                                              47000 R  0542
      X=C.                                                              47100 R  0542
C12****POLICY P IS VALUE OF NUMBER, R(M), APPEARING ON INPUT DATA CARD. 47200 R  0542
    1 P=R(M)                                                            47300 R  0544
      DO 483 L=1,4                                                      47400 R  0545
      DO 483 KK=1,NTE                                                   47500 R  0550
  483 TE(L,KK)=0.                                                       47600 R  0557
      DO 484 L=1,4                                                      47700 R  0560
      DO 484 KM=1,NMUS                                                  47800 R  0566
```

```
  484 MUS(L,KM)=0.                                                   47900 R  0573
      I=FIP(P)                                                       48000 R  0576
      NL=FIM(P)                                                      48100 R  0578
      NNL=FIC(P)                                                     48200 R  0579
C13****TEST FOR THROWAWAY MODULE                                     48300 R  0580
      IF(L.EQ.0) GO TO 3000                                          48400 R  0581
      NDIF=L-NL                                                      48500 R  0583
      IF(NDIF.EQ.0)GO TO 2                                           48600 R  0584
C14****CALCULATE TRANSPORTATION COSTS BETWEEN FIP LEVEL AND FIM LEVEL 48700 R  0586
      CALL TRANSM(I,J,L,NL,NC,TRANST,COSLB,WTH,NDAY,MTBFM,OP         48800 R  0587
     *HRDY,NSHOP,TRANIM,CSTRNM,NUMFS)                                48900 R  0592
      GO TO 3                                                        49000 R  0597
C15****FIP AND FIM ARE PERFORMED AT SAME LEVEL, THEREFORE NO          49100 R  0597
C      TRANSPORTATION COSTS OR MODULE STOCKAGE RAMIFICATIONS.        49200 R  0597
    2 FIPI(I,.)=TUTCSP(I,J,L)                                        49300 R  0598
```

```
      GO TO 4                                                              49400 R  0603.
    3 CONTINUE                                                             49500 R  0605
      STKM(NL,I,J)=0.                                                      49600 R  0605
C16****CALCULATE MODULE STOCKAGE REQUIREMENTS.                              49700 R  0608
   63        CALL REFMUD(I,STKM,NL,NSHOP,NUMFS,MTHFM,NDAY,NMK,K2,TURN1,    49800 R  0609
     *OPHRDY,STKTM,T,STKTMR,ELIFF,STKMR,J,ATRF,ROP)                        49900 R  0616
      T(I,J)=0                                                             50000 R  0621
      TCOST=STKM(NL,I,J)*CC(I,J)                                           50100 R  0624
      IF(NL.NE.4)TCOST=TCOST+STKM(4,I,J)*CC(I,J)                           50200 R  0630
      SUNN=STKMR(I,J)*CC(I,J)                                              50300 R  0637
      SMRT=STKM(NL,I,J)                                                    50400 R  0642
      IF(NL.NE.4)SMRT=SMRT+STKM(4,I,J)                                     50500 R  0645
      TINVIN=((SMRT-STKMR(I,J)/(ELIFE-ROP/12.))/2.+(SMRT-STKMR(I,J)     00050600 R  0650
     */(ELIFE-ROP/12.))*(ELIFE-ROP/12.)+STKMR(I,J)/2.)*CC(I,J)          00050610 R  0656
     **FACTIN                                                           00050620 R  0664
      STCH(I)=TCOST                                                        50700 R  0667
      FIPT(I,J)=TOTCSP(I,J,L)+CSTRNM(I,J)*ELIFE+TCOST+TINVIN+SUNN          50800 R  0668
```

```
    4 IF(X.EQ. 0.) GO TO 7
      IF(FIPT(I,J).GT.FIPS(I,J)) GO TO 5
    7 FIPS(I,J)=FIPT(I,J)
      T(I,J)=0
      LPP(I,J)=FIP(P)
      IF(FIP(P).NE.0) GO TO 5
      T(I,J)=1
    5 M=M+1
      IF(M.GT.MMAX) GO TO 2846
      LL=K(M)
      LX=K(M)
C17****TEST TO SEE IF POLICY HAS SAME FIM BRANCH AS NEXT POLICY TO BE
C      CONSIDERED.
      IF(FIM(P).NE.FIM(LL)) GO TO 2846
C18****FIM BRANCHES ARE IDENTICAL, NOW TEST TO SEE IF FIC OF POLICY IS
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C     SAME AS FIC OF NEXT POLICY.                                     52400 R  0713
      IF(FIC(P).NE.FIC(LI)) GO TO 2846                                52500 R  0714
      X=1.                                                            52600 R  0718
C19****EVALUATE NEXT POLICY FOR SAME MODULE.                          52700 R  0718
      GO TO 1                                                         52800 R  0718
 2846 J=J+1                                                           52900 R  0720
C20****EVALUATE NEXT MODULE FOR ALL FIP S UNDER SAME FIM.             53000 R  0720
      GO TO 99                                                        53100 R  0721
 6442 CONTINUE                                                        53200 R  0722
C21****ALL MODULES HAVE NOW BEEN EVALUATED FOR ALL FIP S UNDER THE    53300 R  0722
C     PARTICULAR FIM AND FIC NOW UNDER CONSIDERATION.                 53400 R  0722
      DO 666 J=1,NMC                                                  53500 R  0722
  666 CONTINUE                                                        53600 R  0728
      SUMP=0.                                                         537[illegible]0 R  0728
      DO 97 J=1,NMC                                                   53800 R  0729
      SUMP=FIPS(I,J) +SUMP                                            53900 R  0734
   97 CONTINUE                                                        54000 R  0738
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C22****CALCULATE PARAMETERS DESCRIBING THE FIM MAINTENANCE FUNCTION.          54100 R  0738
      CALL XFIM(I,NL,NC,AMMHC,NTF,TECI,NMUS,MUS,MUSC,TE,OPHRSH,               54200 R  0738
     *NSHIP,NUMFS,TECM,MUSCM,STCM,TOTCSM,TECUST,MCOST,CC,NMK,T,STKTM,         54300 R  0746
     *TUPM1,MTBFM,NDAE,LPP,OPHRDY,STKMR,FACTIN,ELIFE,XMAN,TRAIN,STKTMR        54400 R  0758
     *,MLEV,NUM,MLEV,MNUM,STKM,TINVIN,TRM,ATRF,PPC,PGM,PUBM,UMF,PROD  )       54500 R  0765
      SUMM=SUMP+TOTCSM(I)                                                     54600 R  0774
      NNL=FTC(P)                                                              54700 R  0776
      NNDIF=NL-NNL                                                            54800 R  0778
      IF(NNDIF.EQ.0 ) GO TO 8                                                 54900 R  0779
C23****CALCULATE TRANSPORTATION OF COMPONENTS DURING MAINTENANCE ACTION        55000 R  0781
      CALL          TRANSC(I,NL,NNL,NC,TRANST,COSLB,WTC,NDAY,MTBFC,OPH        55100 R  0781
     *RDY,NSHUP,TRANIC,CSTRNC,NUMFS)                                          55200 R  0787
      GO TO 9                                                                 55300 R  0791
C24****TOTAL COST OF MAINTENANCE THROUGH FIM FUNCTION IF NO                   55400 R  0791
C     TRANSPORTATION, OR COMPONENT STUCK EFFECTS ARE INVOLVED.                55500 R  0791
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    8 FIMT(I)=SUMM                                                    55600 R  0793
      GO TO 10                                                        55700 R  0794
    9 CONTINUE                                                        55800 R  0796
      STKC(NNL,I)=0.                                                  55900 R  0796
C25****DETERMINE COMPONENT STOCKAGE REQUIREMENTS                      56000 R  0798
 1163      CALL REPCUM(NNL,NSHOP,NUMFS,MTBFC,NDAY,K3,NC,TURN2,OPHRDY  56100 R  0799
     *,STNC,STKTC,TT,STKTCR,ELIFE,STKCR,ATRF,I,ROP)                   56200 R  0804
      TT(I)=0                                                         56300 R  0810
      TCOST=STKC(NNL,I)*CCC(I)                                        56400 R  0812
      IF(NNL.NE.4)TCOST=TCOST+STKC(4,I)*CCC(I)                        56500 R  0816
      SUMN=STKCR(I)*CCC(I)                                            56600 R  0821
      SMRT=STKC(NNL,I)                                                56700 R  0824
      IF(NNL.NE.4)SMRT=SMRT+STKC(4,I)                                 56800 R  0826
      TINVIN=((SMRT-STKCR(I)/(ELIFE-ROP/12.))/2.+(SMRT-STKCR(I)   00056900 R  0830
     */(ELIFE-ROP/12.))*(ELIFE-ROP/12.)+STKCR(I)/2.)*CCC(I)*FACTIN 00056910 R  0834
      FIMT(I)=SUMM+(STRNC(I)*ELIFE+TCOST+SUNNN+TINVIN                 57000 R  0843
   10 IF(Y.NE.0) GO TO 14                                             57100 R  0848
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C26****RESETS POLICY INDICATOR BACK TO FIRST POLICY UNDER PARTICULAR       57200 R  0849
C      FIC BRANCH.                                                          57300 R  0849
       ZZ=IR                                                                57400 R  0850
       GO TO 16                                                             57500 R  0851
C27****TEST FOR LEAST COST FIM.                                             57600 R  0851
    14 IF(FIMT(I).GT.FIMS(I)) GO TO 11                                      57700 R  0852
    16 FIMS(I)=FIMT(I)                                                      57800 R  0856
       NMC=NMK(I)                                                           57900 R  0858
       DO 4617 J=1,NMC                                                      58000 R  0860
C28****SAVE LOCATION OF LEAST COST MAINTENANCE ALLOCATION FOR FIM AND       58100 R  0860
C      FIP FOR EACH COMPONENT AND MODULE RESPECTIVELY.                      58200 R  0860
  4617 LPS(I,J)=LPP(I,J)                                                    58300 R  0866
       LMS(I)=FIM(P)                                                        58400 R  0871
       TT(I)=0                                                              58500 R  0873
       IF(FIM(P).NE.0) GO TO 11                                             58600 R  0875
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      TT(I)=1                                                          58700 R  0878
      NHC=NMK(I)                                                       58800 R  0880
      DO 1463 J=1,NHC                                                  58900 R  0881
 1463 LPS(I,J)=FIP(P)                                                  59000 R  0887
 11   CONTINUE                                                         59100 R  0891
      IF(K.GT.MMAX) GO TO 96                                           59200 R  0891
C29****TEST TO SEE IF FIC OF POLICY BEING EVALUATED IS SAME AS FIC OF  59300 R  0892
C     NEXT POLICY.                                                     59400 R  0892
      IF (FIC(P).NE.FIC(LX)) GO TO 96                                  59500 R  0893
      Y=1.                                                             59600 R  0897
      J=1                                                              59700 R  0897
C30****SETTING IP EQUAL TO K CAUSES NEXT POLICY TO BE EVALUATED.        59800 R  0897
      IK = M                                                           59900 R  0898
      GO TO 15                                                         60000 R  0899
   96 SUMC=SUMC+FIMS(I)                                                60100 R  0900
C31****IP=ZZ CAUSES RETURN TO FIRST POLICY UNDER FIC BRANCH BEING      60200 R  0900
C     EVALUATED AND NEXT COMPONENT IS INVESTIGATED (I=I+1) BY RETURNING 60300 R  0900
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C     TO STATEMENT =100.                                                60400 R 0900
      IR=ZZ                                                             60500 R 0902
      I=I+1                                                             60600 R 0903
      GO TO 100                                                         60700 R 0904
 6441 CONTINUE                                                          60800 R 0905
C32****CALCULATE ALL PARAMETERS CONCERNING FIC MAINTENANCE REQUIREMENTS. 60900 R 0905
      CALL XFIC(NNL,ANMHE,NTL,TEFI,NMUS,MUS,MUSE,IE,UPHRSH,NSHOP,       61000 R 0905
     *NUMFS,TECC,STCC,IUICSC,TECOST,MCOST,CCC,NC,IT,STKTC,TURN2,MTRFC,  61100 R 0912
     *NDAL,L,LMS,UPHRDY,STKCR,FACTIN,ELIFE,XMAN,TRAIN,STKTCR            61200 R 0921
     *,NLEV,NUM,MLEV,MNUM,STKC,MOSCC,TINVIN,TRM,AIRF,PPC,PGC,PURC       61300 R 0926
     *,DEL,PROD)                                                        61400 R 0934
      IDDIF=NNL-1                                                       61500 R 0935
      IF(IDDIF.NE.0) GO TO 12                                           61600 R 0936
C33****COST OF MAINTENANCE THROUGH FIC FUNCTION WHEN NO TRANSPORTATION   61700 P 0937
C     IS REQUIRED (FIC IS PERFORMED AT LEVEL 1)                         61800 R 0937
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      FICT=TOTCSC                                                       61900 R  0938
      GO TO 13                                                          62000 R  0939
   12 CALL         TRANSE (NNL,TRANST,COSLB,WTE,MTBFE,OPHRDY,NSHOP,     62100 R  0940
     *TRANTE,CSTPNE,NDAY,NUMFS)                                         62200 R  0944
      FICT=TOTCSC + CSTRNE*ELIFE                                        62300 R  0946
C34****CALCULATE ALL PARAMETERS DESCRIBING THE CUE MAINTENANCE FUNCTION. 62400 R  0946
   13 CALL XCUE(AMMHCE,NNL,NTE,NMOS,OPHRSH,NSHOP,NUMFS,TECE,            62500 R  0948
     *MOSCE,NDAY,STKE,OPHRDY,MCOST,TECOST,TOTEND,CSEI,TURN2,MTRFE       62600 R  0953
     *,STKFR,XMAN,FLIFE,TRAIN,NLFV,MLEV,NUM,MNUM,TEEC,MOSEC,STKEC,FACTIN 62700 R  0958
     *,TTLVIN,TRF,ATRF,B,G,YK4,PPC,PGE,PUBE,NDAE,IIT,KOP,PROD)          62800 R  0966
C35****TOTAL COST FOR MAINTENANCE EQUALS MAINTENANCE COST THROUGH FIC   62900 R  0971
C       FUNCTION (FICT) + COST OF CUE FUNCTION (TOTEND)                 63000 R  0971
      SUME=SUMC+FICT+TOTEND                                             63100 R  0971
C36****IF FIRST TIME THROUGH GO TO 968 AND SET SUMEMN EQUAL TO SUME.    63200 R  0972
  995 IF(SUMEMN.EQ.0.) GO TO 968                                        63300 R  0973
C37****TEST FOR LEAST COST EQUIPMENT MAINTENANCE.                       63400 R  0974
      IF(SUMF.GT.SUMEMN)GO TO 969                                       63500 R  0975
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  968 SUMLMN=SUMF                                                       63600 R  0978
      DO 310 I=1,NC                                                     63700 R  0978
      NMC=NMK(I)                                                        63800 R  0984
      DO 309 J=1,NMC                                                    63900 R  0986
C38****LPF (I,J) IS OPTIMUM LEVEL FOR FIP UNDER GIVEN FIM, LPS (I,J) IS 64000 R  0987
C     OPTIMUM LEVEL UNDER GIVEN FIC AND LPMIN (I,J) IS OPTIMUM LEVEL FOR 64100 R  0987
C     FIP OF ALL POLICIES.                                              64200 R  0987
      LPMIN(I,J)=LPS(I,J)                                               64300 R  0991
  309 CONTINUE                                                          64400 R  0997
C39****OPTIMUM FIM LEVEL                                                64500 R  0997
      LMMIN(I)=LMS(I)                                                   64600 R  0997
  310 CONTINUE                                                          64700 R  1000
C40****OPTIMUM FIC LEVEL                                                64800 R  1000
      LCMIN=FIC(P)                                                      64900 R  1000
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      IF(LCMIN.NE.0) GO TO 969                                          65000 R  1002
      DO 7931 I=1,NC                                                    65100 R  1004
      NMC=NMK(I)                                                        65200 R  1009
      LMMIN(I)=0                                                        65300 R  1011
      DO 7931 J=1,NMC                                                   65400 R  1013
 7931 LPMIN(I,J)=0                                                      65500 R  1019
                                                              SEGMENT    10 IS 102
                                                       START OF SEGMENT *********
  969 IF(M.GT.MMAX) GO TO 999                                           65600 R  0002
C41****GO TO 998 AND START OVER WITH COMPONENT 1 AND MODULE 1 AND       65700 R  0003
C     PROCEED AS BEFORE ON THE NEXT MAINTENANCE POLICY TO BE EVALUATED. 65800 R  0003
      GO TO 998                                                         65900 R  0004
C42****YOU ARE HERE BECAUSE THERE IS A THROWAWAY. IF THROWAWAY MODULE    66000 R  0004
C     CONTINUE TO THRMOD AND CALCULATE COST THROWAWAY MODULE.           66100 R  0004
 3000 IF(FIM(P).EQ.0) GO TO 150                                         66200 R  0005
          CALL THRMOD(I,J,NL,NSHOP,NUMFS,MTBFM,NDAY,K2,B,G,OPHRDY,STKT  66300 R  0008
     *M,RUP,T,STKTMR,ELIFE,ATRF)                                        66400 R  0014
      SMPT=STKTM(NL,I,J)                                                66500 R  0018
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      IF(NL.NE.4)SMRT=SMRT+STKTM(4,I,J)                                66600 R  0022
      TINVIN=((SMRT-STKTMR(I,J)/(ELIFE-ROP/12.))/2.+(SMRT-STKTMR    00066700 R  0027
     *(I,J)/(ELIFE-ROP/12.))*(ELIFF-ROP/12.)+STKTMR(I,J)/2.)        00066710 R  0032
     **CC(I,J)*FACTIN                                                00066720 R  0040
      FIPT(I,J)=STKTM(NL,I,J)*CC(I,J) +STKTMR(I,J)*CC(I,J)    +TINVIN    66800 R  0043
      IF(NL.NE.4)FIPT(I,J)=FIPT(I,J)+STKTM(4,I,J)*CC(I,J)             66900 R  0056
      GO TO 4                                                          67000 R  0067
C43****THROWAWAY WAS NOT MODULE THROWAWAY, TEST FOR THROWAWAY          67100 R  0067
C     COMPONENT AND PROCEED TO THRCOM IF THROWAWAY COMPONENT.          67200 R  0067
  150 IF(FIC(P).EQ. 0) GO TO 170                                       67300 R  0068
              CALL THRCOM(I,NNL,NSHOP,NUMFS,MTBFC,NDAY,K3,STKTC,OPHRDY,ROP  67400 R  0071
     *,TT,STKTCR,ELIFE,B,G,ATRF)                                       67500 R  0076
      SMRT=STKTC(NNL,I)                                                67600 R  0081
      IF(NNL.NE.4)SMRT=SMRT+STKTC(4,I)                                 67700 R  0084
      TINVIN=((SMRT-STKTCR(I)/(ELIFE-ROP/12.))/2.+(SMRT-STKTCR(I)   00067800 R  0086
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     */(ELIFE-ROP/12.))*(ELIFE-ROP/12.)+STKTCR(I)/2.)*CCC(I)*          00067810 R  0092
     *FACTIN                                                             00067820 R  0099
      FIMT(I)=STKTC(NNL,I)*CCC(I)   +STKTCR(I)*CCC(I)    +TINVIN            67900 R  0100
      IF(NNL.NE.4) FIMT(I)=FIMT(I)+STKTC(4,I)*CCC(I)                        68000 R  0108
      M=M+1                                                                 68100 R  0115
C44****IF LAST POLICY TO BE EVALUATED GO TO NEXT COMPONENT AND RETURN TO    68200 R  0115
C     10 .IF NOT LAST POLICY, SET LX EQUAL TO NUMBER OF NEXT POLICY AND     68300 R  0115
C     RETURN TO 10.                                                         68400 R  0115
      IF(M.GT.MMAX)GO TO 171                                                68500 R  0116
      LX=K(M)                                                               68600 R  0118
 171  GO TO 10                                                              68700 R  0120
  170 CONTINUE                                                              68800 R  0121
      TTT=1                                                                 68900 R  0121
C45****IF YOU GET HERE THEN YOU HAVE A THROWAWAY EQUIPMENT.                  69000 R  0121
      CALL XCDE(AMMHCE,NNL,NTE,NMOS,OPHRSH,NSHOP,NUMFS,TECE,                69100 R  0121
     *MOSCE,NDAY,STKE,OPHRDY,MCOST,TECOST,TOTEND,CSEI,TURN2,MTRFE          69200 R  0127
     *,STKER,XMAN,ELIFE,TRAIN,NLEV,MLEV,NUM,MNUM,TEEC,MOSEC,STKEC,FACTIN   69300 R  0132
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     *,TTNVIN,TRM,ATHF,B,G,XK4,PPC,PGE,PUBE,NDAF,TTT,ROP,PROD)          69400 R  0130
      SUME=TOTEND                                                       69500 R  0145
      M=M+1                                                             69600 R  0145
      GO TO 995                                                         69700 R  0147
  999 CONTINUE                                                          69800 R  0148
C46***END OF OPTIMIZATION PORTION OF GEMM. BEGIN CALCULATIONS FOR KNOWN 69900 R  0148
C     MAINTENANCE POLICY OR RECALCULATION OF OPTIMUM POLICY PARAMETERS  70000 R  0148
      DO 5106 L=1,4                                                     70100 R  0148
      DO 5106 K=1,NCLASP                                                70200 R  0153
      STP(K)=0.                                                         70300 R  0159
      STK(L,K)=0.0                                                      70400 R  0161
 5106 CONTINUE                                                          70500 R  0165
      DO 5114 I=1,NC                                                    70600 R  0166
      NMC=NMK(I)                                                        70700 R  0171
      DO 5114 J=1,NMC                                                   70800 R  0173
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      STKCR(I)=0.                                              70900 R  0178
      STKMR(I,J)=0.                                            71000 R  0180
      DO 5104 KK=1,NIE                                         71100 R  0183
      DO 5104 L=1,4                                            71200 R  0188
      STKC(L,I)=0.                                             71300 R  019
      STKM(L,I,J)=0.                                           71400 R  0197
      NHLEV(L,KK)=0.                                           71500 R  0201
      NNUM(KK)=0.                                              71600 R  0204
 5104 CONTINUE                                                 71700 R  0206
      DO 5105 KM=1,NMUS                                        71800 R  0207
      DO 5105 L=1,4                                            71900 R  0212
      MMLEV(L,KM)=0.                                           72000 R  0218
      MMNUM(KM)=0.                                             72100 R  0221
 5105 CONTINUE                                                 72200 R  0224
 5114 CONTINUE                                                 72300 R  0225
      RDPART=0.                                                72400 R  0226
      CTINVI=0.                                                72500 R  0226
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      CTRM=0.                                                            72600 R  0227
      REST=0.                                                            72700 R  0228
      STKER=0.                                                           72800 R  0229
      YPUB=0.                                                            72900 R  0229
      TTT=0                                                              73000 R  0230
      CALL AMMH(MTTRCE,MTTRE,UPHRDY,NDAY,NC,NMK,MTTRM,MTBFM,            73100 R  0231
     *MTTRC,MTBFC,AMMHM,AMMHC,AMMHE,AMMHCE,MTBFF)                        73200 R  0235
C47****CALCULATE FIP PARAMETERS FOR ALL MODULES OF ALL COMPONENTS        73300 R  0240
      NNI=LCMIN                                                          73400 R  0240
      DO 5108 I=1,NC                                                     73500 R  0241
      NMC=NMK(I)                                                         73600 R  0246
      NL=LMMIN(I)                                                        73700 R  0248
      DO 5107 J=1,NMC                                                    73800 R  0249
      T(I,J)=0                                                           73900 R  0255
      TT(I)=0                                                            74000 R  0258
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```
      L=LPMIN(I,J)                                                      74100 R  0260
      IF(L.EQ.4)AMMHM(I,J)=AMMHM(I,J)*(1.-DMF)                          74200 R  0262
      IF(L.NE.0) GO TO 5100                                             74300 R  0269
      CSTRNM(I,J)=0.0                                                   74400 R  0272
      TRANTM(I,J)=0.0                                                   74500 R  0274
      IF(NNL.NE.0)GO TO 3710                                            74600 R  0277
      TTT=1                                                             74700 R  0279
      GO TO 3711                                                        74800 R  0280
 3710 CONTINUE                                                          74900 R  0282
      IF(NL.EQ.0) GO TO 5108                                            75000 R  0282
      CALL THRMOD(I,J,NL,NSHOP,NUMTS,MTBFM,NDAY,K2,B,G,OPHRDY,          75100 R  0284
     *STKTM,ROP,T,STKIMH,ELIFE,ATRF)                                    75200 R  0291
      STKM(NL,I,J)=STKTM(NL,I,J)                                        75300 R  0295
      T(I,J)=1                                                          75400 R  0301
      GO TO 5107                                                        75500 R  0304
 5100 DO 6800 KK=1,NIE                                                  75600 R  0305
      NLFV(KK)=0.                                                       75700 R  0310
```

```
      NUM(KK)=0.                                                       75800 R 0312
 6800 CONTINUE                                                         75900 R 0315
      DO 6801 KM=1,NMUS                                                76000 R 0315
      MLEV(KM)=0.                                                      76100 R 0320
      MNUM(KM)=0.                                                      76200 R 0322
 6801 CONTINUE                                                         76300 R 0325
      DO 281 KK=1,NTE                                                  76400 R 0325
  281 TE(L,KK)=0.                                                      76500 R 0331
      DO 282 KM=1,NMUS                                                 76600 R 0334
  282 MOS(L,KM)=0.                                                     76700 R 0340
      DO 29 KK=1,NTE                                                   76800 R 0343
C48****DETERMINE TEST EQUIPMENT REQUIREMENTS PER LEVEL FOR FIP          76900 R 0344
      IF(TEMY(I,J,KK).NE.1.) GO TO 29                                  77000 R 0348
      TE(L,KK)=AMMHH(I,J)                                              77100 R 0356
   29 CONTINUE                                                         77200 R 0361
```

```
      DO 21 KM=1,NMOS                                          77300 R  0361
C49****DETERMINE MOS REQUIREMENTS PER LEVEL FOR FIP            77400 R  0362
      IF(IOSM(I,J,KM).NE.1) GO TO 21                           77500 R  0366
      MOS(L,KM)=AMMHM(I,J)                                     77600 R  0371
   21 CONTINUE                                                 77700 R  0377
      TCOST=0.                                                 77800 R  0377
      DO 23 KK=1,NTF                                           77900 R  0378
      XNLEV=TE(L,KK)/(OPHRS(L)*QUAL)*NSHUP(L)                  78000 R  0383
      NLEV(KK)=XNLEV                                           78100 R  0389
      NUM(KK)=NLEV(KK)*NUMFS(L)                                78200 R  0391
      TCOST=TCOST+NUM(KK)*TECOST(KK)                           78300 R  0394
      TECP(I,J)=TCOST                                          78400 R  0398
   23 CONTINUE                                                 78500 R  0401
      Y="TCOST="                                               78600 R  0401
      TRM=0.0                                                  78700 R  0404
      TCOST=0.                                                 78800 R  0405
      DO 25 KM=1,NMOS                                          78900 R  0406
```

```
      PROM=PROD                                                    00078950 R  0411
      IF(L .EQ. 4)PROM=1.                                          00078960 R  0412
      XMLEV=MOS(L,KM)/(UPHRSH(L)*PROM*NDAE)*NSHOP(L)                  79000 R  0414
      MLEV(KM)=XMLEV                                                  79100 R  0420
      MNUM(KM)=MLEV(KM)*NUMFS(L)                                      79200 R  0422
      TCOST=TCOST+MNUM(KM)*MCOST(L,KM)                                79300 R  0426
      MOSCP(I,J)=TCOST                                                79400 R  0430
      TRM= MNUM(KM)*XMAN(KM)*ELIFE/TRAIN(L)+TRM                       79500 R  0433
   25 CONTINUE                                                        79600 R  0439
      TCOST=0.                                                        79700 R  0439
C50****CALCULATE PARTS STOCKAGE REQUIREMENTS                           79800 R  0439
      CALL NONREP (I,J,NCLASP,STK,NSHOP,L, OPHRDY,NDAY,NUMBR,MTBFP,NUMFS 79900 R  0440
     *,K1,B,G,ST,STR,ELIFE,ROP,ATRF)                                  80000 R  0447
      SUM=0.0                                                         80100 R  0453
      TINVTN=0.0                                                      80200 R  0454
```

```
      DO 27 K=1,NCLASP                                             80300 R  0454
      TCOST=TCOST+ST(K)*C(K)                                       80400 R  0460
      STCP(I,J)=TCOST                                              80500 R  0464
      SUM = SUM+STR(K)*C(K)                                        80600 R  0466
      TINVIN=((ST(K)-STR(K)/(ELIFE-ROP/12.))/2.+(ST(K)-STR(K)/  00080700 R  0470
     *(ELIFE-ROP/12.))*(ELIFE-ROP/12.)+STR(K)/2.)*C(K)*         00080710 R  0476
     *FACTIN+TINVIN                                             00080720 R  0482
   27 CONTINUE                                                     80800 R  0485
      PUPP(I,J)=PGP(I,J)*PPC                                       80900 R  0485
C51****ADD UP COSTS OF TEST EQUIPMENT, MAINTENANCE PERSONNEL AND    81000 R  0489
C     STOCKAGE FOR FIP.                                            81100 R  0489
      TOTCSP(I,J,L)=TECP(I,J)+MOSCP(I,J)*ELIFE+STCP(I,J)           81200 R  0490
     *+SUM+TINVIN+TRM +PUBP(I,J)                                   81300 R  0498
      ROPART=ROPART+ SUM                                           81400 R  0504
      TPUB=TPUB+PUBP(I,J)                                          81500 R  0506
      CTINVI=CTINVI+TINVIN                                         81600 R  0509
      CTRM=CTRM+TRM                                                81700 R  0510
```

```
C52****DETERMINE TRANSPORTATION COSTS DURING REPAIR OF MODULES      81800 R  0510
      CALL TRANSM(I,J,L,NL,NC,TRANST,COSLB,WTM,NDAY,MTBFM,          81900 R  0511
     *OPHRDY,NSHOP,TRANTM,CSTRNM,NUMFS)                             82000 R  0517
      DO 5102 KK=1,NIE                                              82100 R  0521
      NNLEV(L,KK)=NNLEV(L,KK) + NLEV(KK)                            82200 R  0527
 5102 CONTINUE                                                      82300 R  0534
      DO 5103 KM=1,NMUS                                             82400 R  0534
      MMLEV(L,KM)=MMLEV(L,KM)+MLEV(KM)                              82500 R  0539
 5103 CONTINUE                                                      82600 R  0546
 5107 CONTINUE                                                      82700 R  0547
 5108 CONTINUE                                                      82800 R  0548
      NNL=LCMIN                                                     82900 R  0549
      DO 5117 I=1,NC                                                83000 R  0549
      NL=LMMIN(I)                                                   83100 R  0555
      IF(NL.NE.0) GO TO 5109                                        83200 R  0557
C53****CALCULATE STOCKAGE REQUIREMENTS FOR THROWAWAY COMPONENTS,     83300 R  0558
      CALL THRCOM(I,NNL,NSHOP,NUMFS,MTBFC,NDAY,K3,STKIC,OPHRDY,ROP,  83400 R  0559
```

```
     * TT,STKTCR,ELIFE,B,G,ATRF)                                   83500 R 0565
      TT(I)=1                                                      83600 R 0570
      STKC(NNL,I)=STKIC(NNL,I)                                     83700 R 0571
      TRANTC(I)=0.0                                                83800 R 0576
      CSTRNC(I)=0.0                                                83900 R 0578
      GO TO 5117                                                   84000 R 0579
 5109 NHC=NMK(I)                                                   84100 R 0581
      DO 5118 J=1,NHC                                              84200 R 0582
      LPS(I,J)=LPMIN(I,J)                                          84300 R 0587
 5118 CONTINUE                                                     84400 R 0593
C54****DETERMINE FIM PARAMETERS                                    84500 R 0593
      CALL XFIM(T,NL,NC,ANMHC,NTF,TECI,NMUS,MUS,MUSC,TE,OPHRSH,     84600 R 0593
     *NSHOP,NUMFS,TECM,MUSCM,STCM,TUTCSM,TECUST,MCUST,CC,NMK,T,STKTM,  84700 R 0601
     *TUPN1,MTBFM,NDAL,LPP,OPHRDY,STKMR,FACTIN,ELIFE,XMAN,TRAIN,STKTMR 84800 R 0613
     *,NLEV,NUM,MLEV,MNUM,STKM,TINVIN,TRM,ATRF,PPC,PGM,PUBM,DMF,PROD)  84900 R 0620
```

```
      TPUB=TPUB+PUBM(I)                                               85000 R  0629
      NMC=NMK(I)                                                      85100 R  0631
      TINVIN=0.0                                                      85200 R  0633
      SUMN=0.0                                                        85300 R  0634
      TCOST =0.                                                       85400 R  0634
      DO 3821 J=1,NMC                                                 85500 R  0635
      L=LPMIN(I,J)                                                    85600 R  0640
      IF(NL.EQ.L) GO TO 3821                                          85700 R  0643
      STKM(NL,I,J)=0.                                                 85800 R  0645
C55****DETERMINE MODULE STOCKAGE                                       85900 R  0648
         CALL REPMOD(I,STKM,NL,NSHOP,NUMFS,MTBFM,NDAY,NMK,K2,TURN1,   86000 R  0649
     *OPHRDY,STKTM,T,STKTMR,ELIFE,STKMR,J,ATRF,RUP)                   86100 R  0656
      T(I,J)=0                                                        86200 R  0662
      TCOST=TCOST+STKM(NL,I,J)*CC(I,J)                                86300 R  0664
      IF(NL.NE.4)TCOST=TCOST+STKM(4,I,J)*CC(I,J)                      86400 R  0671
```

```
      SUNN=SUNN+STKHR(I,J)*CC(I,J)                                    86500 R  0678
      SMRT=STKM(NL,I,J)                                               86600 R  0683
      IF(NL.NE.4)SMRT=SMRT+STKM(4,I,J)                                86700 R  0687
      TINVIN=((SMRT-STKMR(I,J)/(ELIFF-ROP/12.))/2+(SMRT-STKMR(I,J)  00086800 R  0692
     */(FLIFE-ROP/12.))*(ELIFE-ROP/12.)+STKMR(I,J)/2.)*CC(I,J)      00086810 R  0697
     **FACTIN+TINVIN                                                00086820 R  0705
 3821 CONTINUE                                                        86900 R  0709
      CTINVI=CTINVI+TINVIN                                            87000 R  0709
      STCK(I)=TCOST                                                   87100 R  0710
C56****CALCULATE TRANSPORTATION COST DURING REPA   OF COMPONENTS      87200 R  0711
      CALL TRANSC(I,NL,NNL,NC,TRANST,COSLB,WTC,NDAY,MTRFC,            87300 R  0712
     *OPHRDY,NSHOP,TRANTC,CSTRNC,NUMFS)                               87400 R  0718
      DO 5110 KK=1,NIE                                                87500 R  0722
      NNLEV(NL,KK)=NNLEV(NL,KK)+NLEV(KK)                              87600 R  0727
 5110 CONTINUE                                                        87700 R  0734
      DO 5111 KM=1,NMUS                                               87800 R  0734
      MMLEV(NL,KM)=MMLEV(NL,KM)+MLEV(KM)                              87900 R  0739
```

```
 5111 CONTINUE                                                              88000 R  0746
      CTRM=CTRM+TRM                                                         88100 R  0746
 5117 CONTINUE                                                              88200 R  0748
      DO 5119 I=1,NC                                                        88300 R  0748
      LMS(I)=LMMIN(I)                                                       88400 R  0753
 5119 CONTINUE                                                              88500 R  0757
C57****CALCULATE FIC PARAMETERS                                             88600 R  0757
      CALL XFIC(NNL,AMMHE,NTE,TECI,NMUS,MUS,MUSE,TE,UPHRSH,NSHOP,           88700 R  0757
     *NUMFS,TECC,STCC,TOTCSC,TECOST,MCOST,CCC,NC,IT,STKTC,TURN2,MTBFC,      88800 R  0764
     *NDAE,L,LMS,UPHRDY,STKCR,FACTIN,ELIFE,XMAN,TRAIN,STKTCR                88900 R  0773
     *,NLEV,NUM,MLEV,MNUM,STKC,MOSCC,TINVIN,TRM,ATRF,PPC,PGC,PURC           89000 R  0779
     *,DMF,PROD)                                                            89100 R  0786
      TPUR=TPUR+PURC                                                        89200 R  0787
      CALL TRANSF (NNL,TRANST,COSLB,WIE,MTBFE,OPHRDY,NSHOP,                 89300 R  0788
     *TRANTE,CSTRNE,NDAY,NUMFS)                                             89400 R  0793
```

```
     */(ELIFE-ROP/12.))*(ELIFE-ROP/12.)+STKCK(I)/2.)*CCC(I)             00091110 R  0846
     **FACTIN+TINVIN                                                     00091120 R  0852
 3819 CONTINUE                                                              91200 R  0855
      CTINVI=CTINVI+TINVIN                                                  91300 R  0855
      STCC=TCOST                                                            91400 R  0856
      DO 5112 KK=1,NTE                                                      91500 R  0857
      NNLEV(NNL,KK)=NNLEV(NNL,KK)+NLEV(KK)                                  91600 R  0862
 5112 CONTINUE                                                              91700 R  0869
      DO 5113 KM=1,NMOS                                                     91800 R  0869
      MMLEV(NNL,KM)=MMLEV(NNL,KM)+MLEV(KM)                                  91900 R  0874
 5113 CONTINUE                                                              92000 R  0881
      CTRM=CTRM+TRM                                                         92100 R  0881
 3711 CONTINUE                                                              92200 R  0883
C59****DETERMINE COE PARAMETERS                                             92300 R  0883
      CALL XCOE(AMMHCE,NNL,NTE,NMOS,OPHRSH,NSHOP,NUMFS,TECE,                92400 R  0883
```

```
     *MUSCE,NDAY,STKE,OPHRDY,MCOST,TECOST,TOTEND,CSEI,TURN2,MTRFE          92500 R  0888
     *,STKER,XMAN,ELIFE,TRAIN,NLEV,MLEV,NUM,MNUM,TLEC,MOSEC,STKEC,FACTIN   92600 R  0893
     *,TTINVIN,TRM,ATRF,B,G,XK4,PPC,PGE,PUBE,NDAE,TTT,ROP,PROD)           92700 R  0901
      TPUR=TPUR+PUBE                                                      92800 R  0906
      DO 2317 KK=1,NIE                                                    92900 R  0907
      NNLEV(1,KK)=NNLEV(1,KK)+NLEV(KK)                                    93000 R  0912
 2317 CONTINUE                                                            93100 R  0918
      DO 2318 KM=1,NMUS                                                   93200 R  0918
      MMLEV(1,KM)=MMLEV(1,KM)+MLEV(KM)                                    93300 R  0923
 2318 CONTINUE                                                            93400 R  0929
      TOMOS=0.                                                            93500 R  0929
      TOTE=0.                                                             93600 R  0930
C60****DETERMINE TOTAL COSTS IN EACH COST CATEGORY.                       93700 R  0930
      CTRM=CTRM+TRM                                                       93800 R  0931
      CTINVT=CTINVT+TINVIN                                                93900 R  0932
      TOTRMS=CSTRNE                                                       94000 R  0933
      TOSTK=STCC+STKEC                                                    94100 R  0934
```

```
      REST=STKER*CSEI                                        94200 R  0935
      DO 1919 I=1,NC                                         94300 R  0936
      NMC=NMK(I)                                             94400 R  0942
      TOTRNS=TOTRNS+CSTRNC(I)                                94500 R  0944
      TOSTK=TOSTK+STCM(I)                                    94600 R  0946
      REST=REST+STKCR(I)*CCC(I)                              94700 R  0948
      DO 1919 J=1,NMC                                        94800 R  0951
      TOTRNS=TOTRNS+CSTRNM(I,J)                              94900 R  0956
      TOSTK=TOSTK+STCP(I,J)                                  95000 R  0959
      REST=REST+STKMR(I,J)*CC(I,J)                           95100 R  0962
 1919 CONTINUE                                               95200 R  0968
      REST=REST+RUPART                                       95300 R  0969
      WRITE(6,1441)                                          95400 R  0970
 1441 FORMAT(1H1)                                            95500 R  0974
      WRITE(6,9973)                                          95600 R  0974
```

```
     *MOSCE,NDAY,STKE,OPHRDY,MCOST,TECOST,TOTEND,CSEI,TURN2,MTRFE          92500 R  0888
     *,STKER,XMAN,ELIFE,TRAIN,NLEV,MLEV,NUM,MNUM,TLEC,MOSEC,STKEC,FACTIN   92600 R  0893
     *,TINVIN,TRM,ATRF,B,G,XK4,PPC,PGE,PURE,NDAE,ITT,ROP,PROD)             92700 R  0901
      TPUR=TPUR+PURE                                                        92800 R  0906
      DO 2317 KK=1,NIE                                                      92900 R  0907
      NNLEV(1,KK)=NNLEV(1,KK)+NLEV(KK)                                      93000 R  0912
 2317 CONTINUE                                                              93100 R  0918
      DO 2318 KM=1,NMUS                                                     93200 R  0918
      MNLEV(1,KM)=MNLEV(1,KM)+MLEV(KM)                                      93300 R  0923
 2318 CONTINUE                                                              93400 R  0929
      TOMUS=0.                                                              93500 R  0929
      TOTE=0.                                                               93600 R  0930
C00****DETERMINE TOTAL COSTS IN EACH COST CATEGORY.                        93700 R  0930
      CTRM=CTRM+TRM                                                         93800 R  0931
      CTINVT=CTINVT+TINVIN                                                  93900 R  0932
      TOTRNS=CSTRNE                                                         94000 R  0933
      TOSTK=STCC+STKEC                                                      94100 R  0934
```

```
C01****BEGIN PRINTOUT OF OUTPUTS                                  95700 R  0976
 9973 FORMAT(23X,23HRELIABILITY INFORMATION //)                   95800 R  0978
      WRITE(6,9974)                                               95900 R  0978
 9974 FORMAT(26X, 40HITEM         MEAN TIME BETWEEN FAILURE   //) 96000 R  0982
      WRITE(6,9975) MTBFE                                         96100 R  0982
 9975 FORMAT(24X,8HEND ITEM,16X,F8.3)                             96200 R  0992
                                                             SEGMENT   13 IS  1
      DO 9306 I=1,NC                                              96300 R  0992
      WRITE(6,9976) I,MTBFC(I)                                    96400 R  0997
 9976 FORMAT(24X,10HCOMPONENT ,I2,12X,F10.3)                      96500 R  1011
 9306 CONTINUE                                                    96600 R  1011
      DO 9307 I=1,NC                                              96700 R  1011
      NMC=NMK(I)                                                  96800 R  1016
      DO 9307 J=1,NMC                                             96900 R  1018
                                                             SEGMENT   12 IS 10
                                                    START OF SEGMENT ********
      WRITE(6,9977) I,J,MTBFM(I,J)                                97000 R  0002
```

```
9977 FORMAT(24X,7HMODULE ,I2,1H,,I2,15X,F10.3)                97100 R  0018
9307 CONTINUE                                                  97200 R  0018
     DO 9308 K=1,NCLASP                                        97300 R  0020
     WRITE(6,9978) K,MIBFP(K)                                  97400 R  0025
9978 FORMAT(24X,10HPART TYPE  ,I2,7X,F10.0)                    97500 R  0039
9308 CONTINUE                                                  97600 R  0039
     WRITE(6,1441)                                             97700 R  0039
     WRITE(6,9637)                                             97800 R  0042
9637 FORMAT(14X,23HMAINTENANCE  ALLOCATION  //)                97900 R  0047
     WRITE(6,9638)                                             98000 R  0047
9638 FORMAT(10X,31HCOMP   MOD    FIC    FIM    FIP  /)         98100 R  0051
     DO 5204 I=1,NC                                            98200 R  0051
     NMC=NMK(I)                                                98300 R  0056
     NL=LMMIN(I)                                               98400 R  0058
     DO 5204 J=1,NMC                                           98500 R  0059
5204 CONTINUE                                                  98600 R  0066
```

```
      WRITE(6,6007) LCMIN                                         98700 R  0067
      DO 6008 I=1,NC                                              98800 R  0076
      NMC=NMK(I)                                                  98900 R  0081
      WRITE(6,6009) I,LMMIN(I)                                    99000 R  0083
      DO 6008 J=1,NMC                                             99100 R  0096
      WRITE(6,6010) I,J,IPMIN(I,J)                                99200 R  0101
 6008 CONTINUE                                                    99300 R  0118
 6007 FORMAT(26X,I1)                                              99400 R  0119
 6009 FORMAT(11X,I2,21X,I1)                                       99500 R  0119
 6010 FORMAT(11X,I2,6X,I2,20X,I1)                                 99600 R  0119
      WRITE(6,1441)                                               99700 R  0119
      WRITE(6,5150)                                               99800 R  0122
 5150 FORMAT(/////21X,14HPARTS STOCKAGE//)                        99900 R  0126
      WRITE(6,5151)                                              100000 R  0126
 5151 FORMAT(7X,5HLEVEL,5X,5HCLASS,5X,8HQUANTITY,                100100 R  0130
     *5X,4HCOST/)                                                100200 R  0130
```

```
      DO 5128 L=1,4                                                 100300 R  0130
      DO 5128 K=1,NCLASF                                            100400 R  0135
      CSTK(L,K)=STK(L,K)*C(K)                                       100500 R  0141
      WRITE(6,5191)L,K,STK(L,K),CSTK(L,K)                           100600 R  0147
 5191 FORMAT(8X,I2,9X,I2,4X,F10.0,4X,F14.2)                         100700 P  0168
 5128 CONTINUE                                                      100800 R  0168
      WRITE(6,5160)                                                 100900 R  0169
 5160 FORMAT(/////20X,15HMODULE STOCKAGE//)                         101000 R  0173
      WRITE(6,5161)                                                 101100 R  0173
 5161 FORMAT(1X,9HCOMPONENT,3X,6HMODULE,5X,5HLEVEL,5X,5HSTOCK,      101200 P  0177
     *5X,4HCOST/)                                                   101300 R  0177
      DO 5126 L=1,4                                                 101400 R  0177
      DO 5126 I=1,NC                                                101500 R  0182
      NMC=NMK(I)                                                    101600 R  0188
      NL=LMMIN(I)                                                   101700 R  0190
```

```
      DO 5126 J=1,NFC                                             101800 R  0191
      CSTKM(L,I,J)=STKM(L,I,J)*CC(I,J)                            101900 R  0197
      WRITE(6,5129) I,J,L,STKM(L,I,J),CSTKM(L,I,J)                102000 R  0206
 5129 FORMAT(3X,I2,9X,I2,8X,I2,3X,F10.0,F14.2)                    102100 R  0231
 5126 CONTINUE                                                    102200 R  0231
      WRITE(6,5162)                                               102300 R  0232
 5162 FORMAT(/////18X,18HCOMPONENT STOCKAGE//)                    102400 R  0236
      WRITE(6,5163)                                               102500 R  0236
 5163 FORMAT(5X,9HCOMPONENT,3X,6HLEVEL,5X,5HSTOCK,5X,             102600 R  0240
     *4HCOST/)                                                    102700 R  0240
                                                           SEGMENT    15 TS   1
      DO 5130 L=1,4                                               102800 R  0240
      DO 5130 I=1,NC                                              102900 R  0245
      CSTKC(L,I)=STKC(L,I)*CCC(I)                                 103000 R  0251
      WRITE(6,5131)I,L,STKC(L,I),CSTKC(L,I)                       103100 R  0257
 5131 FORMAT(3X,I2,9X,I2,3X,F10.0,F14.2)                          103200 R  0278
 5130 CONTINUE                                                    103300 R  0278
```

```
      ICOF=1                                                 103400 R  0279
      WRITE(6,2321)                                          103500 R  0279
 2321 FORMAT(///// 18X,18HEND ITEM STOCKAGE//)               103600 R  0284
      WRITE(6,2322)                                          103700 R  0284
      WRITE(6,2323) LCDE,STKE,STKEC                          103800 R  0287
 2322 FORMAT(5X,22HLEVEL     STOCK     COST/)                103900 R  0302
 2323 FORMAT(7X,I1,7X,F6.0,5X,F12.2)                         104000 R  0302
      WRITE(6,1441)                                          104100 R  0302
      WRITE(6,5164)                                          104200 R  0305
 5164 FORMAT(/////12X,23HTEST EQUIPMENT PER SHOP//)          104300 R  0309
      DO 5132 I=1,4                                          104400 R  0309
      GO TO (5165,5166,5167,5168),L                          104500 R  0314
 5165 WRITE(6,5169)                                          104600 R  0322
 5169 FORMAT(1X,23HORGANIZATIONAL SUPPORT"/)                 104700 R  0326
      GO TO 5181                                             104800 R  0326
```

```
5166 WRITE(6,5170)                                          104900 R  0327
5170 FORMAT(1X,15HDIRECT SUPPORT*/)                         105000 R  0331
     GO TO 5181                                             105100 R  0331
5167 WRITE(6,5171)                                          105200 R  0332
5171 FORMAT(1X,16HGENERAL SUPPORT*/)                        105300 R  0336
     GO TO 5181                                             105400 R  0336
5168 WRITE(6,5172)                                          105500 R  0337
5172 FORMAT(1X,14HDEPOT SUPPORT*/)                          105600 R  0341
5181 WRITE(6,5206)                                          105700 R  0341
5206 FORMAT(13X,4HTYPE,5X,8HQUANTITY,5X,4HCOST)             105800 R  0345
5173 DO 5132 KK=1,NIE                                       105900 R  0345
     IF(IRD.EQ.0)GO TO 5373                                 106000 R  0350
     NILEV(L,KK)=NNLEV(L,KK)+.9999                          106100 R  0353
     NCLEV(L,KK)=NNLEV(L,KK)                                106200 R  0360
     GO TO 5374                                             106300 R  0364
5373 NCLEV(L,KK)=NNLEV(L,KK)                                106400 R  0366
5374 CNNLEV(L,KK)=NCLEV(L,KK)*TECOST(KK)                    106500 R  0371
```

```
      WRITE(6,5134) KK,NCLEV(L,KK),CNNLEV(L,KK)              106600 R  0376
 5134 FORMAT(14X,I2,7X,F7.3,3X,F14.2)                        106700 R  0395
      NNUM(KK)=NNUM(KK)+NCLEV(L,KK)*NUMFS(L)                 106800 R  0395
 5132 CONTINUE                                               106900 R  0401
      WRITE(6,5182)                                          107000 R  0402
 5182 FORMAT(//8X,33HTOTAL TEST EQUIPMENT REQUIREMENTS/)     107100 R  0406
      WRITE(6,5183)                                          107200 R  0406
 5183 FORMAT(17X,4HTYPE,6X,8HQUANTITY)                       107300 R  0410
      DO 5138 KK=1,NIE                                       107400 R  0410
      WRITE(6,5196) KK,NNUM(KK)                              107500 R  0415
      TOTE=TOTE+NNUM(KK)*IECOST(KK)                          107600 R  0428
 5196 FORMAT(18X,I2,13X,F6.3)                                107700 R  0432
 5138 CONTINUE                                               107800 R  0432
      WRITE(6,1441)                                          107900 R  0432
      WRITE(6,5174)                                          108000 R  0435
```

```
5174 FORMAT(/////10X,30HMAINTENANCE PERSONNEL PER SHOP//)        108100 R  0440
     DO 5135 L=1,4                                              108200 R  0440
     GO TO (5175,5176,5177,5178),L                              108300 R  0445
5175 WRITE(6,5169)                                              108400 R  0453
     GO TO 5180                                                 108500 R  0456
5176 WRITE(6,5170)                                              108600 R  0457
     GO TO 5180                                                 108700 R  0460
5177 WRITE(6,5171)                                              108800 R  0461
     GO TO 5180                                                 108900 R  0464
5178 WRITE(6,5172)                                              109000 R  0465
5180 WRITE(6,5207)                                              109100 R  0469
5207 FORMAT(14X,3HMOS,5X,8HQUANTITY,5X,4HCOST)                  109200 R  0473
                                                              SEGMENT  16 IS  1
5179 DO 5135 KM=1,NMOS                                          109300 R  0473
     IF(IRD.EQ.0) GO TO 5379                                    109400 R  0478
     MILEV(L,KM)=MMLEV(L,KM)+.9999                              109500 R  0481
     MCLEV(L,KM)=MILEV(L,KM)                                    109600 R  0488
```

```
      GO TO 5380                                                        109700 R  0492
 5379 MCLEV(L,KM)=MMLEV(L,KM)                                           109800 R  0494
 5380 CMMLEV(L,KM)=MCLEV(L,KM)*MCOST(L,KM)                              109900 R  0499
      WRITE(6,5137)KM,MCLEV(L,KM),CMMLEV(L,KM)                          110000 R  0505
 5137 FORMAT(14X,I2,/X,F8.3,3X,F14.2)                                   110100 R  0524
      MMNUM(KM)=MMNUM(KM)+MCLEV(L,KM)*NUMES(L)                          110200 R  0524
 5135 CONTINUE                                                          110300 R  0530
      WRITE(6,5184)                                                     110400 R  0531
 5184 FORMAT(//5X,40HINITIAL MAINTENANCE PERSONNEL REQUIREMENTS/)       110500 R  0535
      WRITE(6,5185)                                                     110600 R  0535
 5185 FORMAT(17X,4HHOUS,6X,8HQUANTITY)                                  110700 R  0539
      CTPM=0.                                                           110800 R  0539
      DO 5141 KM=1,NOUS                                                 110900 R  0539
      WRITE(6,5140) KM,MMNUM(KM)                                        111000 R  0545
```

```
5140 FORMAT(18X,I2,13X,F9.3)                                          111100 R  0559
     DO 5141 L=1,4                                                  00111150 R  0559
     TOMOS=TOMOS+MCLEV(L,KM)*NUMFS(L)*MCOST(L,KM)                   00111200 R  0564
     CTRM=CTRM+XMAN(KM)*ELIFE/TPAIN(L)*MCLEV(L,KM)*NUMFS(L)           111400 R  0571
5141 CONTINUE                                                         111500 R  0579
     WRITE(6,1441)                                                    111600 R  0580
     WRITE(6,9980)                                                    111700 R  0583
9980 FORMAT(//30X,16HLIFE CYCLE COSTS     //)                         111800 R  0587
     WRITE(6,3707)RANDU                                               111900 R  0587
3707 FORMAT(30X,12HR AND D COST ,15X,F13.2)                           112000 R  0597
     WRITE(6,3708)PUC                                                 112200 R  0597
3708 FORMAT(30X,15HPRODUCTION COST ,12X,F13.2)                        112300 R  0607
     WRITE(6,9981) TOTE                                               112400 R  0607
9981 FORMAT(30X,15HTEST EQUIPMENT ,13X,F12.2/)                        112500 R  0617
     WRITE(6,9982)                                                    112600 R  0617
9982 FORMAT(30X,6HSTOCKAGE    )                                       112700 R  0621
     WRITE(6,9983) TOSTK                                              112800 R  0621
9983 FORMAT(30X,20HINITIAL PROVISIONING  ,8X,F12.2)                   112900 R  0631
```

```
      WRITE(6,9984) REST                                        113000 R   0631
 9984 FORMAT(30X,13HREORDER STOCK   ,15X,F12.2)                 113100 R   0641
      TSTOCK=REST+TOSTK                                         113200 R   0641
      WRITE(6,9985) TSTOCK                                      113300 R   0642
 9985 FORMAT(30X,11HTOTAL STOCK   ,17X,F12.2/)                  113400 R   0653
      TOMOSS=TOMOS*ELIFE                                        113500 R   0653
      WRITE(6,9986)    TOMOSS                                   113600 R   0654
 9986 FORMAT(30X,8HMANPOWER   ,16X,F16.2/)                      113700 R   0665
      WRITE(6,9987) CTRN                                        113800 R   0665
 9987 FORMAT(30X,8HTRAINING ,20X,F12.2/)                        113900 R   0675
      WRITE(6,9988) CTINVT                                      114000 R   0675
 9988 FORMAT(30X,9HINVENTORY   ,19X,F12.2/)                     114100 R   0685
      TOTRSS=TOTRNS*ELIFE                                       114200 R   0685
      WRITE(6,9989)    TOTRSS                                   114300 R   0686
 9989 FORMAT(30X,14HTRANSPORTATION   ,14X,F12.2/)               114400 R   0697
```

```
      WRITE(6,7116)TPUB                                         114500 R  0697
 7116 FORMAT(30X,11HPUBLICATION   ,17X,F12.2/)                  114600 R  0707
                                                              SEGMENT   17 IS  1
      IOH=0                                                   00114605 R  0707
      IOH=ELIFE/TBOF+.999                                     00114610 R  0707
      OH=IOH-1                                                00114615 R  0712
      OHC=CTOE*OH                                             00114620 R  0713
      DO 8761 I=1,NC                                          00114625 R  0714
      IOH=ELIFE/TBOC(I)+ .999                                 00114630 R  0720
      OH=IOH-1                                                00114635 R  0725
 8761 OHC=OHC+OH*CTOC(I)                                      00114640 R  0727
      DO 8762 I=1,NC                                          00114645 R  0730
      NMC=NMK(I)                                              00114650 R  0735
      DO 8762 J=1,NMC                                         00114655 R  0737
      IOH=ELIFE/TBOM(I,J)+.999                                00114660 R  0742
      OH=IOH-1                                                00114665 R  0748
 8762 OHC=OHC+OH*CTOM(I,J)                                    00114670 R  0750
```

```
      WRITE (6,8771)OHC                                                 00114675 R  0754
 8771 FORMAT(30X,14HOVERHAUL COST=,14X,E12.2/)                          00114680 R  0765
      SUMEMN=TOTRSS+CTINVI+CTRM+TOMUSS+TSTOCK+TOTE                        114700 R  0765
      SUMEMN=SUMEMN+RANDD+PDC+TPUR+OHC                                    114800 R  0768
      WRITE(6,9990)  SUMEMN                                               114900 R  0771
 9990 FORMAT(30X,21HTOTAL LIFE CYCLE COST    ,3X,F16.2//)                 115000 R  0781
      CALL AVAIL(NC,NMK,LPMIN,LMMIN,LCMIN,WAIT,MTBFM,MTTRC,               115100 R  0781
     *REQCT,REQPT,MTBFC,REQMT,MTBFE,MTTRE,MTTRCE,TK1,PENGO,               115200 R  0787
     *TK2,TK3,TK4,MDT,TTF,AVAILA       ,REQEI,TRANS ,MTTRM,REQ)           115300 R  0793
      WRITE(6,9111)AVAILA                                                 115400 R  0797
 9111 FORMAT(30X,24HOPERATIONAL AVAILABILITY,3X,F6.4)                     115500 R  0808
      WRITE(6,1441)                                                       115600 R  0808
      II=II+1                                                             115700 R  0811
      GAVAL(II)=AVAILA *100.                                              115800 R  0812
      GCOST(II)=SUMEMN/1000000.                                           115900 R  0814
```

```
      GCSTE(II)=AVAILA/SUMEMN*1E7*ELIFE                                    116000 R  0818
 1981 READ(5,1979) SENS                                                    116100 R  0825
      WRITE(6,8061)II,SENS                                                 116200 R  0834
 8061 FORMAT(// 30X,11HSENSITIVITY,I3,7X,4HTYPE,I3)                        116300 R  0847
      IF(SENS.EQ.100) GO TO 1433                                           116400 R  0847
      IF(SENS.EQ.0) GO TO 1980                                             116500 R  0849
      GO TO(1330,1331,1332,1333,1334,1335,1336,1337,1338,1339,1340,        116600 R  0851
     *1341,1342,1343,1344,1345,1432,1726,1346,1379,7731),SENS              116700 R  0851
 1433 CONTINUE                                                             116800 R  0871
      IF(II.EQ.1) GO TO 8075                                               116900 R  0871
      CALL GRAPHA(II,GCOST)                                                117000 R  0873
      WRITE(6,1471)                                                        117100 R  0875
 1471 FORMAT(//40X,31HLIFE CYCLE COST  VERSUS POLICY   )                   117200 R  0879
      CALL GRAPHA(II,GAVAL)                                                117300 R  0879
      WRITE(6,1470)                                                        117400 R  0880
 1470 FORMAT(//40X,28HAVAILABILITY  VERSUS  POLICY  )                      117500 R  0885
      CALL GRAPHA(II,GCSTE)                                                117600 R  0885
```

```
      WRITE(6,1472)                                                         117700 R  0886
 1472 FORMAT(//40X,34HCOST EFFECTIVENESS  VERSUS POLICY  )                  117800 R  0891
      WRITE(6,1441)                                                         117900 R  0891
      WRITE(6,8077)                                                         118000 R  0894
 8077 FORMAT(// 45X,13HSUMMARY TABLE //)                                    118100 R  0898
      WRITE(6,8089)                                                         118200 R  0898
 8089 FORMAT(30X,6HPOLICY,4X,4HCOST,11X,5HAVAIL,6X,8HCOST-EFF /)            118300 R  0902
      DO 8076 I=1,II                                                        118400 R  0902
 8076 WRITE(6,8088)I,GCOST(I),GAVAL(I),GCSTE(I)                             118500 R  0908
 8088 FORMAT(33X,I2,F12.5,5X,F8.3,5X,F9.4)                                  118600 R  0927
 8075 CONTINUE                                                              118700 R  0927
      CALL TIMEOFF                                                          118800 R  0927
      END                                                                   118900 R  0927
                                                                          SEGMENT   14 IS 1C
```

```
                                                                START OF SEGMENT *********
      SUBROUTINE MTBFMD(NC,NMK,NCLASP,MTBFP,NUMBR,MTBFM,MTBFIO)          119000 R  0000
C62****THIS SUBROUTINE APPORTIONS PARTS CLASS FAILURE RATES TO EACH      119100 R  0000
C      MODULE.                                                           119200 R  0000
C    GROUP 1                                                           00119300 R  0000
      DIMENSION NMK(4)                                                 00119305 R  0000
C    GROUP 2                                                           00119310 R  0000
      DIMENSION MTBFM(4,22),NUMBR(4,22,38)                             00119315 R  0000
C    GROUP 5                                                           00119320 R  0000
      DIMENSION MTBFP(38)                                              00119325 R  0000
      REAL MTBFM,MTBFP,NUMBR                                             119400 R  0000
      DO 9000 I=1,NC                                                     119500 R  0000
      NMC=NMK(I)                                                         119600 R  0005
      DO 9000 J=1,NMC                                                    119700 R  0007
```

```
      FARAT=0.                                               119800 R  0013
      DO 8000 K=1,NCLASP                                     119900 R  0014
 8000 FARAT = FARAT + NUMBR(I,J,K)/MTBFP(K)                  120000 R  0020
      MTBFM(I,J) = 1.0/FARAT                                 120100 R  0026
 9000 CONTINUE                                               120200 R  0032
      RETURN                                                 120300 R  0033
      END                                                    120400 R  0036
                                                           SEGMENT    19 IS
```

```
                                                              START OF SEGMENT *********
      SUBROUTINE MTBFCM(NC,NMK,MTBFM,MTBFC,MTBFID)                     120500 R  0000
C63****THIS SUBROUTINE APPORTIONS MODULE FAILURE RATES TO EACH COMPONENT 120600 R  0000
C   GROUP 1                                                           00120700 R  0000
      DIMENSION MTBFC(4),NMK(4)                                       00120710 R  0000
C   GROUP 2                                                           00120720 R  0000
      DIMENSION MTBFM(4,22)                                           00120730 R  0000
      DO 9150 I=1,NC                                                    120800 R  0000
      REAL MTBFC,MTBFM                                                  120900 R  0005
      NMC=NMK(I)                                                        121000 R  0005
      FARAT = 0.                                                        121100 R  0007
      DO 9100 J=1,NMC                                                   121200 R  0008
 9100 FARAT = FARAT + 1.0/MTBFM(I,J)                                    121300 R  0014
      MTBFC(I) = 1.0/FARAT                                              121400 R  0020
 9150 CONTINUE                                                          121500 R  0025
      RETURN                                                            121600 R  0025
      END                                                               121700 R  0028
```

```
                                                                START OF SEGMENT *********
      SUBROUTINE MTBFEQ(NC,MTBFC,MTBFE,MTBFID)                               121800 R  0000
C64*****FAILURE RATE OF END ITEM DETERMINED FROM COMPONENT FAILURE RATES.    121900 R  0000
C    GROUP1                                                                00121999 R  0000
      DIMENSION MTBFC( 4)                                                    122000 R  0000
      REAL MTBFE,MTBFC                                                       122100 R  0000
      FARAT=0.                                                               122200 R  0000
      DO 9200 I=1,NC                                                         122300 R  0000
 9200 FARAT = FARAT + 1.0/MTBFC(I)                                           122400 R  0007
      MTBFE = 1.0/FARAT                                                      122500 R  0012
 9260 RETURN                                                                 122600 R  0015
      END                                                                    122700 R  0018
                                                                       SEGMENT   21 IS   2
```

```
                                                              START OF SEGMENT ********
      SUBROUTINE ANMH(MITRCE,MTTRF,OPHRDY,NDAY,NC,NMK,MTTRM,MTBFM,MTTRC,   122800 R  0000
     *MTBFC,AMMHM,AMMHC,AMMHE,AMMHCE,MTBFE)                                 122900 R  0000
C65****THIS SUBROUTINE CALCULATES THE ANNUAL MAINTENANCE MANHOUR            123000 R  0000
C      REQUIREMENTS FOR CHECKING OUT THE EQUIPMENT, AND REPAIRING THE       123100 R  0000
C      EQUIPMENT AND EACH COMPONENT AND EACH MODULE OF THE EQUIPMENT.       123200 R  0000
C   GROUP 1                                                               00123299 R  0000
      DIMENSION AMMHC(4),MTBFC(4),MTTRC(4),NMK(4)                         00123300 R  0000
C   GROUP 2                                                               00123309 R  0000
      DIMENSION AMMHM(4,22),MTBFM(4,22),MTTRM(4,22)                       00123400 R  0000
      REAL MTTRCF,MTTRE,MTTRM,MTTRC,MTBFF,MTBFC,MTBFM,NDAY                  123500 R  0000
      AMMHCE=OPHRDY*MITRCE/MTBFE*NDAY                                       123600 R  0000
      AMMHE=OPHRDY*MTTRE/MTBFE*NDAY                                         123700 R  0002.
```

```
      DO 32 I=1,NC                                           123800 R  0004
      NMC=NMK(I)                                             123900 R  0009
      DO 32 J=1,NMC                                          124000 R  0011
      AMMHM(I,J)=OPHRDY*MITRM(I,J)/MTBFM(I,J)*NDAY           124100 R  0017
   32 CONTINUE                                               124200 R  0027
      DO 34 I=1,NC                                           124300 R  0028
      AMMHC(I)=OPHRDY*MTTRC(I)/MTBFC(I)*NDAY                 124400 R  0033
   34 CONTINUE                                               124500 R  0040
      RETURN                                                 124600 R  0040
      END                                                    124700 R  0043
                                                     SEGMENT   22 IS    73
```

```
                                                                  START OF SEGMENT *********
      SUBROUTINE XFIM (I,NL,NC,AMMHC,NTE,TECI,NMUS,MUS,MOSC,TE,OPHRSH,    124800 R  0000
     *NSHOP,NUMFS,TECM,MOSCM,STCM,TOTCSM,TECOST,MCOST,CC,NMK,T,STKTM,     124900 R  0000
     *TURN1,MTBFM,NDAY,LPP,OPHRDY,STKMR,FACTIN,ELIFE,XMAN,TRAIN,STKTMR    125000 R  0000
     *,NLEV,NUM,MLEV,MNUM,STKM,TINVIN,IRM,ATRF,PPC,PGM,PUBM,DMF,PROD  )   125100 R  0000
C66****THIS SUBROUTINE CALCULATES PARAMETERS DESCRIBING THE FIM           125200 R  0000
C      MAINTENANCE FUNCTION.                                              125300 R  0000
C    GROUP 1                                                            00125399 R  0000
      DIMENSION AMMHC(4),MUSCM(4),NMK(4),PUBM(4),PGM(4),                00125400 R  0000
     *STCM(4),TECM(4),TOTCSM(4)                                         00125450 R  0000
C    GROUP 2                                                            00125499 R  0000
      DIMENSION CC(4,22),LPP(4,22),MOSC(4,22),MTBFM(4,22),              00125500 R  0000
     *STKMR(4,22),STKTMR(4,22),T(4,22)                                  00125550 R  0000
C    GROUP 3                                                            00125599 R  0000
      DIMENSION TECI(4,40)                                              00125600 R  0000
```

```
C     GROUP 6                                                  00125649 R  0000
        DIMENSION NLEV(40),NUM(40),TECOST(40)                  00125650 R  0000
C     GROUP 7                                                  00125699 R  0000
        DIMENSION MLEV(10),MNUM(10),XMAN(10)                   00125700 R  0000
C     GROUP 8                                                  00125749 R  0000
        DIMENSION STKM(4,4,22),STKTM(4,4,22)                   00125750 R  0000
C     GROUP 10                                                 00125799 R  0000
        DIMENSION TE(4,40)                                     00125800 R  0000
C     GROUP 11                                                 00125849 R  0000
        DIMENSION MCOST(4,10),MOS(4,10)                        00125850 R  0000
C     GROUP 12                                                 00125899 R  0000
        DIMENSION NSHOP(4),NUMFS(4),OPHRSH(4),TRAIN(4),        00125900 R  0000
       *TURN1(4)                                               00125950 R  0000
        REAL NSHOP,MCOST,MOS,MOSCM,MTBFM,NDAY                    126000 R  0000
        REAL NLEV,NUM,MLEV,MNUM,NNLEV,MMLEV                      126100 R  0000
        REAL NUMFS                                             00126150 R  0000
        IF(NL.EQ.4)AMMHC(I)=AMMHC(I)*(1.-DMF)                    126200 R  0000
```

```
      DO 6802 KK=1,NTE                                    126300 R   0006
      NLFV(KK)=0.                                         126400 R   0011
      NUM(KK)=0.                                          126500 R   0014
 6802 CONTINUE                                            126600 R   0017
      DO 6803 KM=1,NMUS                                   126700 R   0017
      MLFV(KM)=0.                                         126800 R   0022
      MNUM(KM)=0.                                         126900 R   0025
 6803 CONTINUE                                            127000 R   0028
      DO 2220 KK=1,NTE                                    127100 R   0028
 2220 TL(NL,KK)=0.                                        127200 R   0034
      DO 2219 KM=1,NMUS                                   127300 R   0037
 2219 MOS(NL,KM)=0.                                       127400 R   0044
C67****DETERMINE TEST EQUIPMENT REQUIREMENTS PER LEVEL FOR FIM   127500 R   0046
      DO 58 KK=1,NTE                                      127600 R   0047
      IF(TECI(I,KK).NE.1) GO TO 58                        127700 R   0053
```

```
      TE(NL,KK)=AMMHC(I)+TE(NL,KK)                                       127800 R  0058
   58 CONTINUE                                                           127900 R  0066
C68****DETERMINE MOS REQUIREMENTS PER LEVEL FOR FIM                      128000 R  0066
      DO 59 KM=1,NMOS                                                    128100 R  0066
      IF(MOSC(I,KM).NE.1) GO TO 59                                       128200 R  0071
      MOS(NL,KM)=AMMHC(I)+MOS(NL,KM)                                     128300 R  0076
   59 CONTINUE                                                           128400 R  0084
   65 TCOST=0.                                                           128500 R  0085
C69****DETERMINE TEST EQUIPMENT REQUIREMENTS FOR FIM FOR FORCE STRUCTURE 128600 R  0085
      DO 60 KK=1,NTE                                                     128700 R  0085
      XNLEV=TE(NL,KK)/(OPHRSH(NL)*NDAY)*NSHOP(NL)                        128800 R  0091
      NLEV(KK)=XNLEV                                                     128900 R  0098
      NUM(KK)=NLEV(KK)*NUMFS(NL)                                         129000 R  0101
      TCOST=TCOST+NUM(KK)*TECOST(KK)                                     129100 R  0106
      TECK(I)=TCOST                                                      129200 R  0110
   60 CONTINUE                                                           129300 R  0113
      TCOST=0.                                                           129400 R  0113
```

```
      TRM=0.0                                                          129500 R  0114
C70****CALCULATE MOS REQUIREMENTS FOR ENTIRE FORCE STRUCTURE FOR FIM.  129600 R  0114
      DO 61 KM=1,NMOS                                                  129700 R  0115
      PROM=PROD                                                      00129750 R  0120
      IF(NL.EQ.4)PROM=1.                                             00129760 R  0121
      XMLEV=MOS(NL,KM)/(OPHRSH(NL)*PROM*NDAY)*NSHOP(NL)                129800 R  0123
      MLEV(KM)=XMLEV                                                   129900 R  0131
      MNUM(KM)=MLEV(KM)*NUMFS(NL)                                      130000 R  0133
      TCOST=TCOST+MNUM(KM)*MCOST(NL,KM)                                130100 R  0138
      MOSCM(I)=TCOST                                                   130200 R  0144
C71****DETERMINE TRAINING COSTS                                        130300 R  0145
      TRM=TRM+MNUM(KM)*XMAN(KM)*ELIFE/TRAIN(NL)                        130400 R  0146
   61 CONTINUE                                                         130500 R  0153
      PUBM(I)=PPC*PGM(I)                                               130600 R  0153
      TOTCSM(I)=TECM(I)+MOSCM(I)*ELIFE+TRM+PUBM(I)                     130700 R  0157
      RETURN                                                           130800 R  0165
      END                                                              130900 R  0168
```

```
                                                          START OF SEGMENT **********
      SUBROUTINE XFIC (NNL,AMMHE,NTL,IEEI,NMUS,MUS,MUSE,TE,OPHRSH,NSHOP,  131000 R  0000
     *NUMFS,TECC,STCC,TOTCSC,TECOST,MCOST,CCC,NC,TT,STKTC,TURN2,MTRFC,   131100 R  0000
     * NDAY,L,LMS,OPHRDY,STKCR,FACTIN,ELIFE,XMAN,TRAIN,STKTCR              131200 R  0000
     *,NLEV,NUM,MLEV,MNUM,STKC,MOSCC,TINVIN,TRM,ATRF,PPC,PGC,PUBC          131300 R  0000
     *,OMF,PROD)                                                          131400 R  0000
C72****CALCULATE PARAMETERS DESCRIBING FIC MAINTENANCE ACTION.           131500 R  0000
C    GROUP 1                                                           00131599 R  0000
      DIMENSION CCC(4),LMS(4),MTRFC(4),STKCR(4),STKTCR(4),            00131600 R  0000
     *TT(4)                                                            00131650 R  0000
C    GROUP 6                                                           00131699 R  0000
      DIMENSION NLEV(40),NUM(40),TECOST(40),IEEI(40)                   00131700 R  0000
C    GROUP 7                                                           00131749 R  0000
      DIMENSION MLEV(10),MNUM(10),MUSE(10),XMAN(10)                    00131750 R  0000
```

```
C     GROUP 8                                                  00131799 R  0000
        DIMENSION STKC(4,4),STKTC(4,4)                         00131800 R  0000
C     GROUP 10                                                 00131849 R  0000
        DIMENSION TE(4,40)                                     00131850 R  0000
C     GROUP 11                                                 00131899 R  0000
        DIMENSION MCOSI(4,10),MOS(4,10)                        00131900 R  0000
C     GROUP 12                                                 00131949 R  0000
        DIMENSION NSHOP(4),NUMFS(4),OPHRSH(4),TRAIN(4),        00131950 R  0000
       *TURN2(4)                                               00132000 R  0000
        REAL NSHOP,MCOSI,MOS,MOSCC,MTBFC,NDAY                    132100 R  0000
        REAL NLEV,NUM,MLEV,MNUM,NNLEV,MMLEV                      132200 R  0000
        REAL NUMFS                                             00132250 R  0000
        IF(NNL.EQ.4)AMMHE=AMMHE*(1.-DMF)                         132300 R  0000
        DO 6804 KK=1,NIL                                         132400 R  0003
        NLEV(KK)=0.                                              132500 R  0008
        NUM(KK)=0.                                               132600 R  0011
 6804 CONTINUE                                                   132700 R  0014
        DO 6805 KM=1,NMUS                                        132800 R  0014
```

213

```
      MLFV(KM)=0.                                                      132900 R  0019
      MNEM(KM)=0.                                                      133000 R  0022
 6805 CONTINUE                                                         133100 R  0025
      DO 2221 KK=1,NTE                                                 133200 R  0025
 2221 TE(NNL,KK)=0.                                                    133300 R  0031
      DO 2222 KM=1,NMUS                                                133400 R  0034
 2222 MOS(NNL,KM)=0.                                                   133500 R  0041
      STCC = 0.                                                        133600 R  0044
      DO 163 KK=1,NTE                                                  133700 R  0045
C73****CALCULATE TEST EQUIPMENT REQUIREMENTS PER LEVEL FOR FIC.         133800 R  0046
      IF(TFEI(KK).NE.1.) GO TO 163                                     133900 R  0050
      TE(NNL,KK)=AMNME+TE(NNL,KK)                                      134000 R  0054
  163 CONTINUE                                                         134100 R  0061
C74****DETERMINE MOS REQUIREMENTS PER LEVEL FOR FIC                     134200 R  0061
```

```
      DO 164 KM=1,NMUS                                                    134300 R  0061
      IF(MOSE(KM).NE.1) GO TO 164                                         134400 R  0066
      MOS(NNL,KM)=AMMHE+MUS(NNL,KM)                                       134500 R  0070
  164 CONTINUE                                                            134600 R  0077
C75****CALCULATE TEST EQUIPMENT REQUIREMENTS FOR FIC FOR FORCE STRUCTURE  134700 R  0077
  162 TCOST=0.                                                            134800 R  0078
      DO 165 KK=1,NTE                                                     134900 R  0078
      XNLEV=TE(NNL,KK)/(OPHRSH(NNL)*NDAY)*NSHOP(NNL)                      135000 R  0084
      NLEV(KK)=XNLEV                                                      135100 R  0091
      NUM(KK)=NLEV(KK)*NUMFS(NNL)                                         135200 R  0094
      TCOST=TCOST+NUM(KK)*TECOST(KK)                                      135300 R  0099
      TECC=TCOST                                                          135400 R  0103
  165 CONTINUE                                                            135500 R  0105
      TRM=0.0                                                             135600 R  0105
      TCOST=0.0                                                           135700 R  0106
C76****CALCULATE MOS REQUIREMENTS FOR FIC FOR FORCE STRUCTURE,            135800 R  0106
      DO 66 KM=1,NMOS                                                     135900 R  0107
      PROM=PROD                                                         00135940 R  0112
```

```
      IF(NNL .EQ.4)PROM=1.                                                 00135950 R  0113
        XMLEV=MOS(NNL,KM)/(UPHRSH(NNL)*PROM*NDAY)*NSHOP(NNL)                 136000 R  0115
        MLEV(KM)=XMLEV                                                       136100 R  0123
        MNUM(KM)=MLEV(KM)*NUMFS(NNL)                                         136200 R  0125
        TCOST=TCOST+MNUM(KM)*MCOST(NNL,KM)                                   136300 R  0130
        MISCC=TCOST                                                          136400 R  0136
C77****CALCULATE TRAINING REQUIREMENTS FOR FIC MAINTENANCE.                  136500 R  0136
        TRM=TRM+MNUM(KM)*XMAN(KM)*ELIFE/TRAIN(NNL)                           136600 R  0136
   66 CONTINUE                                                               136700 R  0144
        TCOST=0.                                                             136800 R  0144
   67 CONTINUE                                                               136900 R  0146
        PURC=PPC*PGC                                                         137000 R  0146
C78****ADD UP TOTAL FIC COSTS.                                                137100 R  0146
        TOTCSC=TECC+MISCC*ELIFE+TRM+PURC                                     137200 R  0147
        RETURN                                                               137300 R  0150
        END                                                                  137400 R  0153
                                                                       SEGMENT   24 IS  2
```

```
                                                                 START OF SEGMENT ********
      SUBROUTINE TRANSM(I,J,L,NL,NC,TRANST,COSLB,WTM,NDAY,MTBFM,OPHRDY     137500 R  0000
     *,NSHOP,TRANTM,CSTRNM,NUMFS)                                          137600 R  0000
C79****CALCULATE TRANSPORTATION COSTS FOR SHIPPING MODULES FROM FIM        137700 R  0000
C     LEVEL TO FTP LEVEL.                                                  137800 R  0000
C    GROUP 2                                                             00137899 R  0000
      DIMENSION CSTRNM(4,22),MTBFM(4,22),NOFAIL(4,22),                   00137900 R  0000
     *TRANTM(4,22),WTM(4,22)                                             00137950 R  0000
C    GROUP 12                                                            00137999 R  0000
      DIMENSION COSLB(4,4),NSHOP(4),NUMFS(4),TRANST(4,4)                 00138000 R  0000
      REAL MTBFM,NSHOP,NDAY                                                138100 R  0000
      REAL NUMFS                                                         00138150 R  0000
      NOFAIL(I,J)=NSHOP(NL)*OPHRDY*NDAY/MTBFM(I,J) + .9999                 138200 R  0000
      TRANTM(I,J)=TRANST(L,NL)                                             138300 R  0010
      NOFAIL(I,J)=NOFAIL(I,J)*NUMFS(NL)                                    138400 R  0015
      CSTRNM(I,J)=COSLB(L,NL)*WTM(I,J)*NOFAIL(I,J)*TRANTM(I,J)             138500 R  0022
      RETURN                                                               138600 R  0035
      END                                                                  138700 R  0038
```

```
                                                                 START OF SEGMENT ********
      SUBROUTINE TRANSC(I,NL,NNL,NC,TRANSI,CUSLB,WTC,NDAY,MTBFC,OPHRDY,   138800 R  0000
     *NSHOP,TRANTC,CSTRNC,NUMFS)                                          138900 R  0000
C80****DETERMINE TRANSPORTATION COSTS FOR SHIPPING COMPONENTS FROM FIC    139000 R  0000
C     LEVEL TO FIM LEVEL.                                                 139100 R  0000
C    GROUP 1                                                            00139199 R  0000
      DIMENSION CSTRNC(4),MTBFC(4),NOFAIC(4),TRANTC(4),WTC(4)           00139200 R  0000
C    GROUP 12                                                           00139299 R  0000
      DIMENSION CUSLB(4,4),NSHOP(4),NUMFS(4),TRANSI(4,4)                00139300 R  0000
      REAL MTBFC,NSHOP,NDAY                                               139400 R  0000
      REAL NUMFS                                                        00139450 R  0000
      NOFAIC(I)=NSHOP(NNL)*OPHRDY*NDAY/MTBFC(I) + .9999                   139500 R  0000
      NOFAIC(I)=NOFAIC(I)*NUMFS(NNL)                                      139600 R  0008
      TRANTC(I)=TRANSI(NL,NNL)                                            139700 R  0013
      CSTRNC(I)=CUSLB(NL,NNL)*WTC(I)*NOFAIC(I)*TRANTC(I)                  139800 R  0017
      RETURN                                                              139900 R  0026
      END                                                                 140000 R  0029
```

```
                                                        START OF SEGMENT *******
      SUBROUTINE TRANSE(NNL,TRANST,COSLB,WTE,MTBFE,OPHRDY,NSHOP,         140100 R  0000
     *TRANTE,CSTRNE,NDAY,NUMFS)                                          140200 R  0000
CB1****CALCULATE TRANSPORTATION COSTS FOR SHIPPING END ITEM FROM COE     140300 R  0000
C     LEVEL TO FIC LEVEL.                                                140400 R  0000
C   GROUP 12                                                           00140499 R  0000
      DIMENSION COSLB(4,4),NSHOP(4),NUMFS(4),TRANST(4,4)               00140500 R  0000
      REAL MTBFE,NSHOP,NDAY                                              140600 R  0000
      REAL NUMFS                                                       00140650 R  0000
      NOFATE=NSHOP(1)*OPHRDY*NDAY/MTBFE + .9999                          140700 R  0000
      NOFAIE=NOFAIE*NUMFS(1)                                             140800 R  0005
      TRANTE=TRANST(NNL,1)                                               140900 R  0007
      CSTRNE=COSLB(NNL,1)*WTE*NOFAIE*TRANTE                              141000 R  0009
      RETURN                                                             141100 R  0012
      END                                                                141200 R  0015
```

```
                                                              START OF SEGMENT ********
      SUBROUTINE THRMOD(I,J,NL,NSHOP,NUMFS,MTBFM,NDAY,K2,B,G,OPHRDY,STKT  141300 R  0000
     *M,POP,T,STKTMR,ELIFE,ATRF)                                          141400 R  0000
C82****THIS SUBROUTINE CALCULATES STOCKAGE REQUIREMENTS IF MODULES ARE    141500 R  0000
C     THROWN AWAY.                                                        141600 R  0000
C    GROUP 2                                                            00141699 R  0000
      DIMENSION MTBFM(4,22),STKTMR(4,22),T(4,22)                        00141700 R  0000
C    GROUP 8                                                            00141749 R  0000
      DIMENSION STKTH(4,4,22)                                           00141750 R  0000
C    GROUP 12                                                           00141799 R  0000
      DIMENSION B(4),G(4),NSHOP(4),NUMFS(4)                             00141800 R  0000
      REAL MTTRCE,MTTRE,MTTRM,MTTRC,MTBFE,MTBFC,MTBFM,MTBFP,NSHOP,        141900 R  0000
     *MCOST,LIMCUM,NUMBR,MOS,MOSCP,K1,K2,K3,NDAY                          142000 R  0000
      REAL NUMFS                                                        00142050 R  0000
```

```
      STKTM(4,I,J)=0.                                                  142100 R  0000
C83****CALCULATE MODULE FAILURES DURING 15 DAY PERIOD.                 142200 R  0003
      FAILMT=OPHRDY*NDAY*.04/MTBFM(I,J)                                142300 R  0003
C84****ASSIGN STOCKAGE OBJECTIVE PERIOD ACCORDING TO LEVEL OF THROWAWAY 142400 R  0007
      GO TO(750,751,752,753),NL                                        142500 R  0010
  750 T6=E(1)                                                          142600 R  0018
      GO TO 754                                                        142700 R  0019
  751 T6=E(2)                                                          142800 R  0020
      GO TO 754                                                        142900 R  0021
  752 TO=E(3)                                                          143000 R  0023
      GO TO 754                                                        143100 R  0024
  753 T6=E(4)                                                          143200 R  0026
C85****CALCULATE INITIAL ISSUE STOCKAGE                                143300 R  0026
  754 TXFAIL=TO*NSHOP(NL)*FAILMT                                       143400 R  0028
      TSTK=TXFAIL+K2*SQRT (TXFAIL)                                     143500 R  0031
      NTSTK=TSTK+.9999                                                 143600 R  0033
      STKTM(NL,I,J)=NTSTK*NUMFS(NL)                                    143700 R  0037
C86****ASSIGN ORDER-SHIPPING TIMES ACCORDING TO LEVEL OF THROWAWAY     143800 R  0041
```

```
      GO TO(760,761,762,763),NL                                      143900 R 0043
  760 TH=G(1)                                                        144000 R 0051
      GO TO 764                                                      144100 R 0052
  761 TH=G(2)                                                        144200 R 0053
      GO TO 764                                                      144300 R 0054
  762 TH=G(3)                                                        144400 R 0056
      GO TO 764                                                      144500 R 0057
  763 TH=G(4)                                                        144600 R 0059
C87****CALCULATE ORDER-SHIP STOCKAGE                                 144700 R 0059
  764 TSTK=TH*NSHOP(NL)*FAILMT                                       144800 R 0061
      NTSTK=TSTK+.9999                                               144900 R 0064
      STKTM(NL,I,J)=NTSTK*NUMFS(NL)+STKTM(NL,I,J)                    145000 R 0067
C88****CALCULATE REPLACEMENT STOCKAGE AT DEPOT                        145100 R 0073
      STKTM(4,I,J)=2.*RUP*NSHOP(4)*NUMFS(4)*FAILMT +STKTM(4,I,J)     145200 R 0077
```

```
C89*****CALCULATE REORDER STOCKAGE                                     145300 R  0084
      MTKTMR=(FAILMT*24.*(ELIFE-ROP/12.)*NSHOP(NL)*NUMFS(NL))*         145400 R  0087
     *(1.+ATRF)+.999                                                  00145450 P  0093
      STKTMR(I,J)=MTKTMR                                               145500 R  0097
      RETURN                                                           145600 R  0100
      END                                                              145700 R  0103
                                                                  SEGMENT    28 TS   13
```

```
                                                              START OF SEGMENT *******
      SUBROUTINE THRCUM(I,NNL,NSHOP,NUMFS,MTBFC,NDAY,K3,STKTC,OPHRDY,RUP   145800 R  0000
     *,TT,STKTCR,ELIFE,B,G,ATRF)                                            145900 R  0000
C90****THIS SUBROUTINE CALCULATES COMPONENT STOCKAGE FOR THROWAWAY          146000 R  0000
C     COMPONENTS.                                                           146100 R  0000
C    GROUP 1                                                              00146199 R  0000
      DIMENSION MTBFC(4),STKTCR(4),TT(4)                                  00146200 R  0000
C    GROUP 2                                                              00146249 R  0000
      DIMENSION STKTC(4,22)                                               00146250 R  0000
C    GROUP 12                                                             00146299 R  0000
      DIMENSION B(4),G(4),NSHOP(4),NUMFS(4)                               00146300 R  0000
      REAL MTTRCF,MTIME,MTTRM,MTTRC,MTBFF,MTBFC,MTBFM,MTBFP,NSHOP,          146400 R  0000
     *MCOST,LAMCUM,NUMRR,MOS,MOSCP,K1,K2,K3,NDAY                            146500 R  0000
      REAL NUMFS                                                          00146550 R  0000
      STKTC(4,I)=0.                                                         146600 R  0000
```

```
C91****CALCULATE COMPONENT FAILURES IN 15 DAY PERIOD                          146700 R  0002
      FAILCT=OPHRDY*NDAY*.04/MTBFC(I)                                         146800 R  0002
C92****ASSIGN STOCKAGE OBJECTIVE PERIOD ACCORDING TO LEVEL OF COMPONENT       146900 R  0006
C     THROWAWAY.                                                              147000 R  0006
      GO TO(770,771,772,773),NNL                                              147100 R  0008
  770 TTO=R(1)                                                                147200 R  0016
      GO TO 774                                                               147300 R  0017
  771 TTO=R(2)                                                                147400 R  0018
      GO TO 774                                                               147500 R  0019
  772 TTO=R(3)                                                                147600 R  0021
      GO TO 774                                                               147700 R  0022
  773 TTO=R(4)                                                                147800 R  0024
C93****DETERMINE INITIAL-ISSUE STOCKAGE                                       147900 R  0024
  774 TFAIL=TTO*NSHOP(NNL)*FAILCT                                             148000 R  0026
      TTSTK=TFAIL+K3*SQRT (TFAIL)                                             148100 R  0029
      NTTSTK=TTSTK+.9999                                                      148200 R  0031
      STKIC(NNL,I)=NTTSTK*NUMFS(NNL)                                          148300 R  0035
```

```
C94****ASSIGN ORDER-SHIPPING TIMES ACCORDING TO LEVEL OF COMPONENT      148400 R  0038
C      THROWAWAY.                                                       148500 R  0038
       GO TO (780,781,782,783),NNL                                      148600 R  0040
  780  TTM=G(1)                                                         148700 R  0048
       GO TO 784                                                        148800 R  0049
  781  TTM=G(2)                                                         148900 R  0050
       GO TO 784                                                        149000 R  0051
  782  TTM=G(3)                                                         149100 R  0053
       GO TO 784                                                        149200 R  0054
  783  TTM=G(4)                                                         149300 R  0056
C95****CALCULATE ORDER-SHIP STOCKAGE                                    149400 R  0056
  784  TTSTK=TTM*ASHOP(NNL)*FAILCT                                       149500 R  0058
       NTSTK=TTSTK+.9999                                                149600 R  0061
       STKTC(NNL,I)=NTSTK*NUMFS(NNL)+STKTC(NNL,I)                       149700 R  0064
```

```
C96****DETERMINE REPLACEMENT STOCKAGE REQUIREMENTS AT THE DEPOT         149800 R  0069
      STKTC(4,I)=2.*RUP*NSHOP(4)*NUMFS(4)*FAILCT+STKTC(4,I)              149900 R  0072
C97****CALCULATE REORDER STOCKAGE                                        150000 R  0078
      MTKTCR=(FAILCT*24.*(ELIFE-RUP/12.)*NSHOP(NNL)*NUMFS(NNL))*         150100 R  0080
     *(1.+ATRF)+.99                                                     00150150 R  0086
      STKTCR(I)=MTKTCR                                                   150200 R  0090
      RETURN                                                             150300 R  0092
      END                                                                150400 R  0095
                                                                  SEGMENT    29 IS  1
```

```
                                                              START OF SEGMENT ********
      SUBROUTINE NONREP(I,J,NCLASP,STK,NSHOP,L,OPHRDY,NDAY,NUMBR,MTBFP,     150500 R  0000
     *NUMFS,F1,B,G,ST,STR,ELIFE,RUP,ATRF)                                    150600 P  0000
C9B****THIS SUBROUTINE DETERMINES PARTS STOCKAGE REQUIREMENTS.               150700 R  0000
C     GROUP 2                                                              00150799 R  0000
      DIMENSION NUMBR(4,22,38)                                             00150800 R  0000
C     GROUP 5                                                              00150849 R  0000
      DIMENSION MTBFP(38),ST(38),ST1(38),ST2(38),ST3(38),                  00150850 R  0000
     *STR(38)                                                              00150900 R  0000
C     GROUP 9                                                              00150924 R  0000
      DIMENSION STK(4,38)                                                  00150925 R  0000
C     GROUP 12                                                             00150949 R  0000
      DIMENSION B(4),G(4),NSHOP(4),NUMFS(4)                                00150950 R  0000
      REAL MTTRCF,MTIRE,MTTRM,MTTRC,MTBFF,MTBFC,MTBFM,MTBFP,NSHOP,            151000 R  0000
     *MCOST,LAMCUM,NUMBR,MOS,MOSCP,K1,K2,K3,NDAY                              151100 R  0000
```

```
      READ NUMFS                                                  00151150 R  0000
      DO 701 K=1,NCLASP                                             151200 R  0000
      STR(K)=0.0                                                    151300 R  0005
      ST1(K)=0.                                                     151400 R  0008
      ST2(K)=0.                                                     151500 R  0009
      ST3(K)=0.                                                     151600 R  0011
C99****CALCULATE FAILURES IN A 15 DAY-PERIOD FOR EACH PARTS CLASS   151700 R  0012
      FAIL=NUMBR(I,J,K)*OPHRDY*NDAY*.04/MTBFP(K)                    151800 R  0013
C100***ASSIGN STOCKAGE OBJECTIVE PERIOD BASED ON LEVEL OF FIP.      151900 R  0020
      GO TO (702,703,704,705),L                                     152000 R  0022
  702 Q=R(1)                                                        152100 R  0030
      GO TO 706                                                     152200 R  0031
  703 Q=R(2)                                                        152300 R  0032
      GO TO 706                                                     152400 R  0033
  704 Q=R(3)                                                        152500 R  0035
      GO TO 706                                                     152600 R  0036
  705 Q=R(4)                                                        152700 R  0038
```

```
C101***CALCULATE INITIAL ISSUE PARTS STOCKAGE              152800 R  0038
  706 YFAIL=Q*NSHOP(L)*FAIL                                152900 R  0040
      STKK=YFAIL+K1*SQRT (XFAIL)                           153000 R  0043
      NSTK=STKK+.9999                                      153100 R  0045
      ST3(K)=NSTK*NUMFS(I)                                 153200 R  0049
      STK(L,K)=ST3(K)+STK(L,K)                             153300 R  0052
C102***ASSIGN ORDER-SHIP PERIODS BASED ON FIP LEVEL        153400 R  0056
      GO TO (716,707,708,709),L                            153500 R  0059
  716 H=G(1)                                               153600 R  0067
      GO TO 710                                            153700 R  0068
  707 H=G(2)                                               153800 R  0069
      GO TO 710                                            153900 R  0070
  708 H=G(3)                                               154000 R  0072
      GO TO 710                                            154100 R  0073
  709 H=G(4)                                               154200 R  0075
```

```
C103***CALCULATE ORDER-SHIPPING STOCKAGE FOR PARTS                  154300 R  0075
  710 STKK=H*NSHOP(L)*FAIL                                          154400 R  0077
      NSTK=STKK+.9999                                               154500 R  0080
      ST1(K)=NSTK*NUMFS(L)                                          154600 R  0083
      STK(L,K)=ST1(K)+STK(L,K)                                      154700 R  0086
C104***CALCULATE PARTS REPLACEMENT STOCK AT THE DEPOT                154800 R  0090
      ST2(K)=2.*ROP*NSHOP(L)*NUMFS(L)*FAIL                          154900 R  0093
      STK(4,K)=ST2(K)+STK(4,K)                                      155000 R  0099
      ST(K)=  ST1(K)+ST2(K)+ST3(K)                                  155100 R  0105
C105***DETERMINE PARTS REORDER STOCKAGE                              155200 R  0109
      MTF=(FAIL*24.*(ELIFE-ROP/12.)*NSHOP(L)*NUMFS(L))*(1.+ATRF)+.9999  155300 R  0111
      STR(K)=MTR                                                    155400 R  0121
  701 CONTINUE                                                      155500 R  0124
      RETURN                                                        155600 R  0124
      END                                                           155700 R  0127
                                                              SEGMENT    30 IS  1
```

```
                                                         START OF SEGMENT ********
      SUBROUTINE REPMOD(I,STKM,NL,NSHOP,NUMFS,MTBFM,NDAY,NMK,K2,TURN1,     155800 R  0000
     *OPRRDY,STKTM,T,STKTMR,ELIFF,STKMR,J,ATKF,RUP)                        155900 P  0000
C106***THIS SUBROUTINE CALCULATES MODULE STOCKAGE WHEN MODULES ARE          156000 R  0000
C      REPAIRABLE.                                                          156100 R  0000
C     GROUP 1                                                            00156199 R  0000
      DIMENSION NMK(4)                                                   00156200 R  0000
C     GROUP 2                                                            00156224 R  0000
      DIMENSION MTBFM(4,22),STKMR(4,22),STKTMR(4,22),T(4,22)             00156225 R  0000
C     GROUP 8                                                            00156249 R  0000
      DIMENSION STKM(4,4,22),STKTM(4,4,22)                               00156250 R  0000
C     GROUP 12                                                           00156299 R  0000
      DIMENSION NSHOP(4),NUMFS(4),TURN1(4)                               00156300 R  0000
      REAL MTTRCF,MTIRE,MITRM,MTTRC,MTBFE,MTBFC,MTBFM,MTBFP,NSHOP,          156400 R  0000
     *MCOST,LAMCUM,NUMBR,MOS,MOSCP,K1,K2,K3,NDAY                            156500 R  0000
      REAL NUMFS                                                         00156550 R  0000
```

```
      STKK(4,I,J)=0.0                                       156600 R  0000
      IF(T(I,J).EQ.1)GO TO 809                              156700 R  0003
C107***DETERMINE MODULE FAILURES PER 15 DAY PERIOD          156800 R  0007
      FAILM=OPHRDY*NDAY*.04/MTBFM(I,J)                      156900 R  0008
C108***ASSIGN ORDER-SHIPPING TIMES DEPENDING UPON FIM LEVEL. 157000 R  0011
      GO TO (800,801,802,803 ),NL                           157100 R  0014
  800 QQ=TURN1(1)                                           157200 R  0022
      GO TO 804                                             157300 R  0023
  801 QQ=TURN1(2)                                           157400 R  0024
      GO TO 804                                             157500 R  0025
  802 QQ=TURN1(3)                                           157600 R  0027
      GO TO 804                                             157700 R  0028
  803 QQ=TURN1(4)                                           157800 R  0030
C109***CALCULATE PIPELINE STOCKAGE OF MODULES               157900 R  0030
  804 XXFAIL=QQ*FAILM*NSHOP(NL)                             158000 R  0032
      STKKK=XXFAIL+K2*SQRT (XXFAIL)                         158100 R  0035
```

```
      NNSTK=STKKK+.9999                                              158200 R  0037
      STKM(NL,I,J)=NNSTK*NUMFS(NL)                                   158300 R  0041
C110***CALCULATE REORDER MODULE STOCKAGE                             158400 R  0045
      MTKMR=(FAILM*24.*(ELIFE-ROP/12.)*NSHOP(NL)*NUMFS(NL))*ATRF+.9999 158500 R  0047
      STKMR(I,J)=MTKMR                                               158600 R  0057
      GO TO 799                                                      158700 R  0060
  800 STKM(NL,I,J)=STKTM(NL,I,J)                                     158800 R  0062
      STKMR(I,J)=STKTMR(I,J)                                         158900 R  0069
      IF(NL.EQ.4)GO TO 799                                           159000 R  0075
      STKM(4,I,J)=STKTM(4,I,J)                                       159100 R  0077
  799 CONTINUE                                                       159200 R  0084
      RETURN                                                         159300 R  0084
      END                                                            159400 R  0087
                                                              SEGMENT    31 IS  1
```

```
                                                              START OF SEGMENT ********
      SUBROUTINE REPCUM(NNL,NSHOP,NUMFS,MIBFC,NDAY,K3,NC,TURN2,OPHRDY     159500 R  0000
     *,STKC,STKTC,TT,STKTCR,ELIFE,STKCR,ATRF,I,RUF)                       159600 R  0000
C111***THIS SUBROUTINE CALCULATES COMPONENT STOCKAGE WHEN COMPONENTS ARE  159700 R  0000
C     REPAIRABLE.                                                         159800 R  0000
C    GROUP 1                                                            00159899 R  0000
      DIMENSION MTRFC(4),STKCR(4),STKTCR(4),TT(4)                       00159900 R  0000
C    GROUP 8                                                            00159949 R  0000
      DIMENSION STKC(4,4),STKTC(4,4)                                    00159950 R  0000
C    GROUP 12                                                           00159999 R  0000
      DIMENSION NSHOP(4),NUMFS(4),TURN2(4)                              00160000 R  0000
      REAL MTTRCF,MTIKE,MITRU,MTTRC,MIBFE,MTHFC,MTHFM,MTRFP,NSHOP,        160100 R  0000
     *MCOST,LAMCUM,NUMBR,NUS,NUSCP,K1,K2,K3,NDAY                          160200 R  0000
      REAL NUMFS                                                        00160250 R  0000
      STKC(4,I)=0.0                                                       160300 R  0000
```

```
      IF(TT(I).EQ.1) GO TO 914                                  160400 R  0002
C112***DETERMINE FAILURES OF COMPONENT PER 15 DAY PERIOD        160500 R  0005
      FAILC=OPHRDY*NDAY*.04/MTBFC(I)                            160600 R  0006
C113***ASSIGN ORDER-SHIP PERIODS BASED ON LEVEL OF FIC          160700 R  0009
      GO TO(901,902,903,904),NNL                                160800 R  0011
  901 YQ=TURN2(1)                                               160900 R  0019
      GO TO 910                                                 161000 R  0020
  902 YQ=TURN2(2)                                               161100 R  0021
      GO TO 910                                                 161200 R  0022
  903 YQ=TURN2(3)                                               161300 R  0024
      GO TO 910                                                 161400 R  0025
  904 YQ=TURN2(4)                                               161500 R  0027
C114***CALCULATE COMPONENT PIPELINE STOCKAGE                    161600 R  0027
  910 YXFATL=YQ*FAILC*NSHOP(NNL)                                161700 R  0029
      YSTKK=YXFATL+K3*SQRT (YXFATL)                             161800 R  0032
      MNSTK=YSTKK+.9999                                         161900 R  0034
      STKC(NNL,I)=MNSTK*NUMFS(NNL)                              162000 R  0038
```

```
C115***CALCULATE COMPUNENT REORDER STUCKAGE                      162100 R  0041
      MTKCR=(FAILC*24.*(ELIFE-HOP/12.)*NSHOP(NNL)*NUMFS(NNL))*ATRF+  162200 R  0043
     *.9999                                                    00162250 R  0049
      STKCR(I)=MTKCR                                             162300 R  0053
      GO TO 900                                                  162400 R  0055
  914 STKC(NNL,I)=STKIC(NNL,I)                                   162500 R  0057
      STKCR(I)=STKTCR(I)                                         162600 R  0062
      IF(NNL.EQ.4) GO TO 900                                     162700 R  0066
      STKC(4,I)=STKTC(4,I)                                       162800 R  0068
  900 CONTINUE                                                   162900 R  0073
      RETURN                                                     163000 R  0073
      END                                                        163100 R  0076
                                                           SEGMENT    32 IS  1
```

```
                                                              START OF SEGMENT ********
      SUBROUTINE XCDF(ASMHCE,NNL,NTE,NMOS,OPHRSH,NSHUP,NUMFS,TFCF,    163200 R  0000
     *MUSCF,MDAY,STKE,OPHRDY,MCUST,TECUST,TOTEND,CSEI,TURN_,MTRFF      163300 R  0000
     *,STFFR,XMAN,ELIFE,TRAIN,NLEV,MLEV,NUM,MNUM,TEE,MOSEC,STKEC,FACTIN 163400 R  0000
     *,TTRVTN,TRM,ATRF,H,G,XK4,PPC,PGE,PUBE,NDAE,TTT,ROP,PROD)         163500 R  0000
C116***THIS SUBROUTINE CALCULATES PARAMETERS DESCRIBING CUE.          163600 R  0000
C     GROUP 6                                                      00163699 R  0000
      DIMENSION MLEV(40),NUM(40),TECE(40),TECUST(40)               00163700 R  0000
C     GROUP 7                                                      00163749 R  0000
      DIMENSION MLEV(10),MNUM(10),MUSCE(10),XMAN(10)               00163750 R  0000
C     GROUP 10                                                     00163799 R  0000
      DIMENSION TE(4,40)                                           00163800 R  0000
C     GROUP 11                                                     00163849 R  0000
      DIMENSION MCOST(4,10),MUS(4,10)                              00163850 R  0000
C     GROUP 12                                                     00163899 R  0000
```

```
      DIMENSION R(4),G(4),NSHOP(4),NUMFS(4),OPHRSH(4),            00163900 R  0000
     *TRAIN(4),TURN2(4)                                            00164100 R  0000
      REAL NSHOP,MCOST,MUS,NDAY,MTBFE                                164200 R  0000
      REAL NLEV,NUM,MLEV,MNUM,NNLEV,MMLEV,MOSEC,NDAE                 164300 R  0000
      REAL NUMFS                                                   00164350 R  0000
      DO 2319 KM=1,NMUS                                              164400 R  0000
      MNUM(KM)=0.                                                    164500 R  0005
      MLEV(KM)=0.                                                    164600 R  0008
      MOS(1,KM)=0.                                                   164700 R  0010
 2319 CONTINUE                                                       164800 R  0013
      DO 2320 KK=1,NTE                                               164900 R  0013
      NLEV(KK)=0.                                                    165000 R  0018
      NUM(KK)=0.                                                     165100 R  0021
 2320 TE(1,KK)=0.                                                    165200 R  0024
C117***CALCULATE TEST EQUIPMENT REQUIREMENTS FOR COE AT ORGANIZATIONAL 165300 R  0025
C      LEVEL                                                         165400 R  0025
      DO 487 KK=1,NTE                                                165500 R  0026
```

```
      IF(TFCE(KK).NE.1)GO TO 487                                       165600 R  0032
      TE(1,KK)=AMMHCE                                                  165700 R  0036
  487 CONTINUE                                                         165800 R  0039
C118***CALCULATE MOS REQUIREMENTS FOR COE AT ORGANIZATIONAL LEVEL      165900 R  0039
      DO 488 KM=1,NMOS                                                 166000 R  0039
      IF(MOSCE(KM).NE.1)GO TO 488                                      166100 R  0044
      MOS(1,KM)=AMMHCE                                                 166200 R  0048
      STKE=0.                                                          166300 R  0050
  488 CONTINUE                                                         166400 R  0052
      STKEC=0.                                                         166500 R  0052
C119** TEST FOR THROWAWAY EQUIPMENT                                    166600 R  0052
      IF(ITT.NE.1) GO TO 1347                                          166700 R  0053
C120***CALCULATE END ITEM STOCKAGE FOR THROWAWAY EQUIPMENT.            166800 R  0054
            CALL  NREPE(DPHRDY,NDAY,MTBFE,NSHUP,XK4,NUMFS,B,G,ROP,ELIFE   166900 R  0055
```

```
      *,ATHF,STKEP,STKE)                                              167000 R  0061
       GO TO 1348                                                     167100 R  0062
 1347  CONTINUE                                                       167200 R  0063
       IF(1.NE.NNI)GO TO 489                                          167300 R  0063
       GO TO 490                                                      167400 R  0065
C121***DETERMINE END ITEM STOCKAGE REQUIREMENTS FOR REPAIRABLE END ITEMS 167500 R  0065
  489  CALL  REPEND(NSHUP,NUMFS,XK4,TURN2,OPHRDY,STKE,NDAY,MTBFE       167600 R  0066
      *,STKFR,ELIFL,AIRF,RUP)                                         167700 R  0070
 1348  CONTINUE                                                       167800 R  0072
       STKEC=STKE*CSF1                                                167900 R  0072
  490  TCOST=0.                                                       168000 R  0074
C122***DETERMINE TEST EQUIPMENT REQUIREMENTS FOR CUE FOR FORCE STRUCTURE 168100 R  0074
       DO 492 KK=1,NTE                                                168200 R  0074
       XNLEV=TE(1,KK)/(OPHRSH(1)*NDAE)*NSHUP(1)                       168300 R  0080
       NLEV(KK)=XNLEV                                                 168400 R  0084
       NUM(KK)=NLEV(KK)*NUMFS(1)                                      168500 R  0087
  492  TCOST=TCOST+NUM(KK)*TECOST(KK)                                 168600 R  0092
       TEEC=TCOST                                                     168700 R  0096
```

```
      TCOST=0.                                                        168800 R  0097
      TRM=0.0                                                         168900 R  0098
C123***CALCULATE MOS REQUIREMENTS FOR COE FOR FORCE STRUCTURE         169000 R  0098
      DO 493 KM=1,NMOS                                                169100 R  0099
      PROM=PROD                                                     00169150 R  0104
      XMLEV=MOS(1,KM)/(UPHRSH(1)*PROM*NDAL)*NSHOP(1)                  169200 R  0105
      MLEV(KM)=XMLEV                                                  169300 R  0110
      MNUM(KM)=MLEV(KM)*NUMES(1)                                      169400 R  0112
      TCOST=TCOST+MNUM(KM)*MCOST(1,KM)                                169500 R  0116
C124***CALCULATE TRAINING COSTS FOR COE REPAIRMEN                     169600 R  0118
      TRM=TRM+MNUM(KM)*XMAN(KM)*FLIFE/TRAIN(1)                        169700 R  0121
  493 CONTINUE                                                        169800 R  0127
      MOSEC =TCOST                                                    169900 R  0127
```

```
C125***CALCULATE INVENTORY MANAGEMENT COSTS                       170000 R   0127
      TIIVIN=((STKE-STKER/(ELIFE-ROP/12.))/2.+(STKE-STKER/(ELIFE-  00170100 R   0128
     *ROP/12.))*(ELIFE-ROP/12.)+STKER/2)*CSEI*FACTIN              00170110 R   0131
      PURE=PPC*PGE                                                  170200 R   0137
C126***ADD UP COE COSTS                                             170300 R   0137
      TOTEND =STKEC+IEEC+HUSEC*ELIFE+STKFR*CSEI+IINVIN+TRH+PUBF     170400 R   0138
      RETURN                                                        170500 R   0143
      END                                                           170600 R   0146
                                                               SEGMENT   33 IS  2
```

```
                                                          START OF SEGMENT ********
      SUBROUTINE REPEND(NSHOP,NUMFS,XK4,TURN2,OPHRDY,STKE,NDAY,MTBFF      170700 R  0000
     *,STKER,ELIFE,ATRF,ROP)                                               170800 R  0000
C127***THIS SUBROUTINE CALCULATES END ITEM STOCKAGE FOR REPAIRABLE END     170900 R  0000
C      ITEMS                                                               171000 R  0000
C     GROUP 12                                                           00171099 R  0000
      DIMENSION NSHOP(4),NUMFS(4),TURN2(4)                                 171100 R  0000
      REAL NDAY,NSHOP,MTBFE                                                171200 R  0000
      REAL NUMFS                                                         00171250 R  0000
C128***CALCULATE PIPELINE STOCKAGE OF END ITEMS                             171300 R  0000
      FAILE=OPHRDY*NDAY*.04/MTBFE                                          171400 R  0000
      XFAIL=TURN2(1)*FAILE*NSHOP(1)                                        171500 R  0004
      XSTKE=XFAIL+XK4*SQRT(XFAIL)                                          171600 R  0006
      MSTKE=XSTKE+.9999                                                    171700 R  0008
      STKE=MSTKE*NUMFS(1)                                                  171800 R  0012
C129***CALCULATE END ITEM REORDER STOCK                                     171900 R  0012
      MTKER=(FAILE*24.*(ELIFE-ROP/12.)*NSHOP(1)*NUMFS(1))*ATRF+.9999       172000 R  0013
      STKER=MTKER                                                          172100 R  0021
      RETURN                                                               172200 R  0022
      END                                                                  172300 R  0025
```

```
                                                          START OF SEGMENT ***.****
      SUBROUTINE  NREPE(OPHRDY,NDAY,MTBFE,NSHOP,XK4,NUMFS,B,G,RDP,FLIFE   172400 R  0000
     *,ATRF,STKER,STKE)                                                   172500 R  0000
C130***THIS SUBROUTINE CALCULATES END ITEM STOCKAGE FOR A THROWAWAY END   172600 R  0000
C     ITEM                                                                172700 R  0000
C    GROUP 12                                                           00172799 R  0000
      DIMENSION B(4),G(4),NSHOP(4),NUMFS(4)                             00172800 R  0000
      REAL NDAY,MTBFE,NSHOP                                               172900 R  0000
      REAL NUMFS                                                        00172950 R  0000
      FAIL=OPHRDY*NDAY*.04/MTBFE*NSHOP(1)                                 173000 R  0000
C131***INITIAL ISSUE STOCK                                                173100 R  0003
      ISTK=FAIL*B(1)+XK4*SQRT(FAIL*B(1))+.999                             173200 R  0005
      ISTK=ISTK*NUMFS(1)                                                  173300 R  0011
C132***ORDER-SHIP STOCK                                                   173400 R  0011
```

```
      NOSSTK=FAIL*G(1)+.999                                           173500 R  0013
      NOSSTK=NOSSTK+NUMFS(1)                                          173600 R  0017
C133***REPLACEMENT STUCK                                              173700 R  0017
      NROFST=FAIL*2*RUP*NUMFS(1)+.999                                 173800 R  0019
      STKL=ISTK+NOSSTK+NROPST                                         173900 R  0024
C134***REORDER STOCK                                                  174000 R  0025
      MTKER=(FAIL*24.*(ELIFE-ROP/12.)*NUMFS(1))*(1.+ATRF)+.999        174100 R  0026
      STKER=MTKER                                                     174200 R  0033
      RETURN                                                          174300 R  0034
      END                                                             174400 R  0037
                                                                   SEGMENT   35 IS
```

```
                                                            START OF SEGMENT ********
      SUBROUTINE AVAIL(NC,NMK,LPMIN,LMMIN,LCMIN,WAIT,MTBFM,          174500 R  0000
     *MTTRC,REQCT,REQPT,MTBFC,REQMT,MTBFF,MTTRE,MTTRCE,              174600 R  0000
     *TK1,PENGO,TK2,TK3,TK4,HDT,TTE,AVAILA      ,REQET,TRANS,MTTRM,REQ)   174700 R  0000
C135***THIS SUBROUTINE CALCULATES THE EQUIPMENT OPERATIONAL AVAILABILITY  174800 R  0000
      REAL NDAY,NSHOP                                                174900 R  0000
C     GROUP 1                                                      00174999 R  0000
      DIMENSION LMMIN(4),MTBFC(4),MTTRC(4),NMK(4),TRC(4),          00175000 R  0000
     *TTM(4)                                                       00175100 R  0000
C     GROUP 2                                                      00175199 R  0000
      DIMENSION LPMIN(4,22),MTBFM(4,22),MTTRM(4,22),TM(4,22)       00175200 R  0000
C     GROUP 8                                                      00175299 R  0000
      DIMENSION REQC(11,4),REQMT(4,4),REQPT(4,22),TRANS(4,4),      00175300 R  0000
     *WATT(4),WETT(4)                                              00175310 R  0000
      REAL MTTRM,MTTRC,MTTRE,MTTRCE,MTBFM,MTBFC,MTBFE                175400 R  0000
```

```
      SUMS=0.                                                   175500 R  0000
      SUM=0.                                                    175600 R  0000
      DO 921 I=1,NC                                             175700 R  0001
      NMC=NMK(I)                                                175800 R  0006
      DO 920 J=1,NMC                                            175900 R  0008
      L=LPMIN(I,J)                                              176000 R  0014
C136***TEST FOR THROWAWAY MODULE, COMPONENT AND EQUIPMENT       176100 R  0015
      IF(LPMIN(I,J).NE.0) GO TO 922                             176200 R  0017
      IF(LMMIN(I).NE.0) GO TO 923                               176300 R  0022
      IF(LCMIN.NE.0) GO TO925                                   176400 R  0025
      TTF=RFQET                                                 176500 R  0028
      GO TO 1417                                                176600 R  0028
  922 L=LPMIN(I,J)                                              176700 R  0030
      NL=LMMIN(I)                                               176800 R  0033
      NNL=LCMIN                                                 176900 R  0035
C137***CALCULATE TURNAROUND TIME FOR REPAIRABLE MODULES          177000 R  0035
      WETT(L)=WATT(L)                                         00177010 R  0035
```

```
      IF(LMMIN(I).EQ.LPMIN(I,J))WEIT(L)=0                          00177020 R  0038
      TM(I,J)=2.*TRANS(L,NL)+WEIT(L)+MITRM(I,J)+(1-TK1)*REQPT(I,4)   177100 R  0045
      GO TO924                                                       177200 R  0057
  923 NL=LMMIN(I)                                                    177300 R  0059
      NNL=LCMIN                                                      177400 R  0061
C138***CALCULATE TURNAROUND TIME FOR THROWAWAY MODULES                177500 R  0061
      TM(I,J)=RFOMT(NL,4)                                            177600 R  0061
C139***DETERMINE WEIGHTED SUM OF MODULE TURNAROUND                    177700 R  0064
  924 SUM=SUM+TM(I,J)/MTBFM(I,J)                                     177800 R  0066
  920 CONTINUE                                                       177900 R  0072
C140***CALCULATE WEIGHTED AVERAGE TURNAROUND TIME FOR MODULES.        178000 R  0072
      TM(I)=MTBFC(I)*SUM                                             178100 R  0072
      GO TO 927                                                      178200 R  0076
  925 NNL=LCMIN                                                      178300 R  0077
C141***CALCULATE TURNAROUND TIME FOR THROWAWAY COMPONENTS             178400 R  0077
```

```
      TRC(I)=REQCT(NNL,4)                                            178500 R  0077
      GO TO 928                                                      178600 R  0080
C142***CALCULATE TURNAROUND TIME FOR REPAIRABLE COMPONENTS           178700 R  0080
  927 WEIT(NL)=WAIT(NL)                                            00178710 R  0082
      IF(LMMIN(I).EQ.LCMIN)WEIT(NL)=0                              00178720 R  0085
      TRC(I)=2.*TRANS(NL,NNL)+WEIT(NL)+MTTRC(I)+TIM(I)*(1-TK2)     00178800 R  0089
C143***DETERMINE WEIGHTED SUM OF COMPONENT TURNAROUND TIME.           178900 R  0098
  928 SUMS = SUMS+1./MTBFC(I)*TRC(I)                                 179000 R  0100
  921 CONTINUE                                                       179100 R  0105
C144***CALCULATE WEIGHTED AVERAGE TURNAROUND TIME FOR COMPONENTS      179200 R  0105
      TTC=MTBFF*SUMS                                                 179300 R  0105
C145***CALCULATE TURN AROUND TIME FOR REPAIRABLE EQUIPMENT.           179400 R  0105
      WEIT(NNL)=WAIT(NNL)                                          00179410 R  0106
      IF (LCMIN.EQ.1)WEIT(NNL)=0                                   00179420 R  0109
      TTF=PENGO*(MTTRCE+2.*TRANS(1,1))+(1-PENGO)*(2.*TRANS(NNL,1)    179500 R  0113
     ++WEIT(NNL)+MTTRE+(1-TK3)*TTC)                                  179600 R  0116
C146***CALCULATE MEAN DOWN TIME OF EQUIPMENT                         179700 R  0121
```

```
      MDT=(TK4*REQ  )+(1-TK4)*TTE                                  179800 R  0122
      IF(LCMIN.EQ.1) GO TO 1417                                    179900 R  0125
C147***DETERMINE AVAILABILITY WHEN END ITEM MAINTENANCE FLOAT IS   180000 R  0126
C     AVAILABLE.                                                   180100 R  0126
      AVAILA=MTBFE/(MTBFE+MDT)                                     180200 R  0127
      GO TO 1418                                                   180300 R  0129
C148***DETERMINE AVAILABILITY WITHOUT END ITEM FLOAT                180400 R  0129
 1417 AVAILA=MTBFE/(MTBFE+TTE)                                     180500 R  0130
 1418 CONTINUE                                                     180600 R  0132
      RETURN                                                       180700 R  0132
      END                                                          180800 R  0135
                                                              SEGMENT   36 TS  1
```

```
                                                                START OF SEGMENT ********
      SUBROUTINE  GRAPHA(II,VALUE)                                     180900 R  0000
C149***THIS SUBROUTINE YIELDS GRAPHICAL PRINT OUT FROM THE RESULTS OF  181000 R  0000
C      SENSITIVITY ANALYSIS.                                           181100 R  0000
      DIMENSION LINE(400),VALUE(40)                                    181200 R  0000
      BLANK=" "                                                        181300 R  0000
      DOT="."                                                          181400 R  0002
      ASTR="*"                                                         181500 R  0005
      DO 1462 I=1,100                                                  181600 R  0008
 1462 LINE(I)=DOT                                                      181700 R  0014
C150***PRINT DOTS FOR Y-AXIS                                           181800 R  0015
      WRITE(6,1463)(LINE(I),I=1,100)                                   181900 R  0016
 1463 FORMAT(1H1,100A1)                                                182000 R  0034
C151***II IS THE NUMBER OF BARS TO BE PRINTED                          182100 R  0034
      DO 1465 I=1,II                                                   182200 R  0034
```

```
      DO 1464 LL=1,100                                                 182300 R  0039
 1464 LINE(LL)=BLANK                                                   182400 R  0046
C152***PRINT THREE DOTS BETWEEN BARS OF BARCHART                       182500 R  0047
      DO 1466 J=1,3                                                    182600 R  0048
      LINE(1)=DOT                                                      182700 R  0054
 1466 WRITE(6,1467)(LINE(K),K=1,100)                                   182800 R  0057
 1467 FORMAT(1H ,100A1)                                                182900 R  0075
C153***PRINT BAR HAVING HEIGHT EQUAL TO VALUE (I) USING ASTERISKS.     183000 R  0075
      J=VALUE(I)                                                       183100 R  0075
      DO 1468 JJ=2,J                                                   183200 R  0077
 1468 LINE(JJ)=ASTR                                                    183300 R  0083
C154***IF VALUE (I) IS LARGER THAN 100 UNITS, DENOTE BY PRINTING DOT AT 183400 R  0084
C      TOP OF BAR.                                                     183500 R  0084
      IF(JJ.GT.100) LINE(100)=DOT                                      183600 R  0085
      WRITE(6,1467)(LINE(L),L=1,100)                                   183700 R  0089
 1455 CONTINUE                                                         183800 R  0106
C155***PRINT 3 DOTS ON X-AXIS AFTER LAST BAR.                          183900 R  0106
```

```
      DO 1441 J=1,100                                    184000 R  0106
 1441 LINE(J)=BLANK                                      184100 R  0112
      DO 1469 I=1,3                                      184200 R  0114
      LINE(I)=DOT                                        184300 R  0120
 1469 WRITE(6,1467)(LINE(M),M=1,100)                     184400 R  0123
      RETURN                                             184500 R  0140
      END                                                184600 R  0143
                                                       SEGMENT   37 IS  1
```